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# THE INTERNATIONAL SUGAR·JOURNAL

A·TECHNICAL·&·COMMERCIAL PERIODICAL·DEVOTED·ENTIRELY TO·THE·SUGAR·INDUSTRY

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For LIST OF ADVERTISERS see page lii

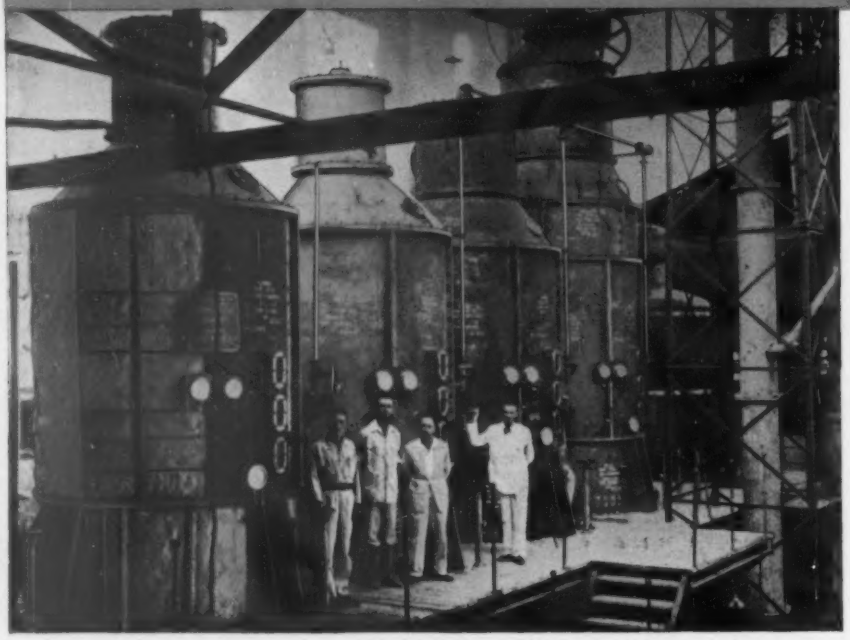
BLAIRS

COMPLETE

# SUGAR

## FACTORIES & REFINERIES

## DISTILLERIES, ABSOLUTE ALCOHOL & CHEMICAL PLANTS



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Our illustration shows Quadruple Effet Evaporating Plant installed in a Sugar Factory in Brazil.

# BLAIRS LIMITED

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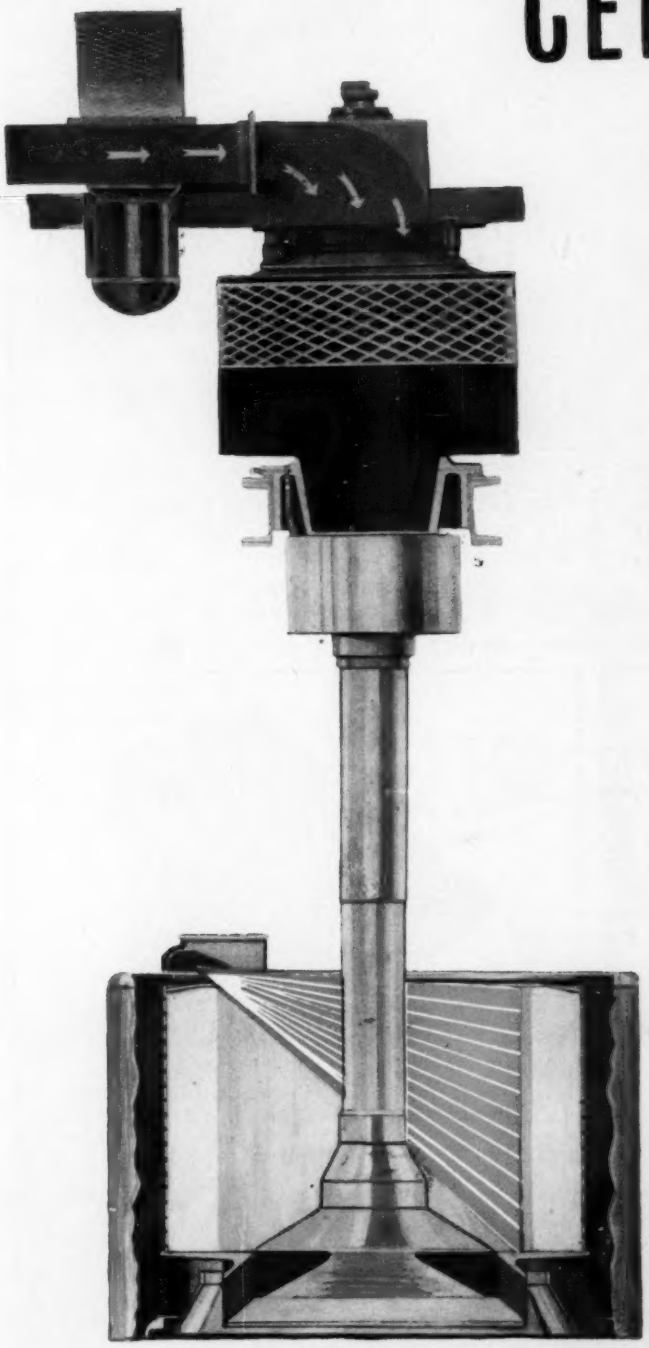
# BROADBENT Sugar CENTRIFUGALS



## AUTOMATIC PROCESS WASHING

by a single oscillating, non-choking jet, with the unit mounted on the monitor casing top.

The speed of nozzle rotation reduces downwards, and increases upwards to give even washing at the cake.

We also supply the spray nozzle type static jets.

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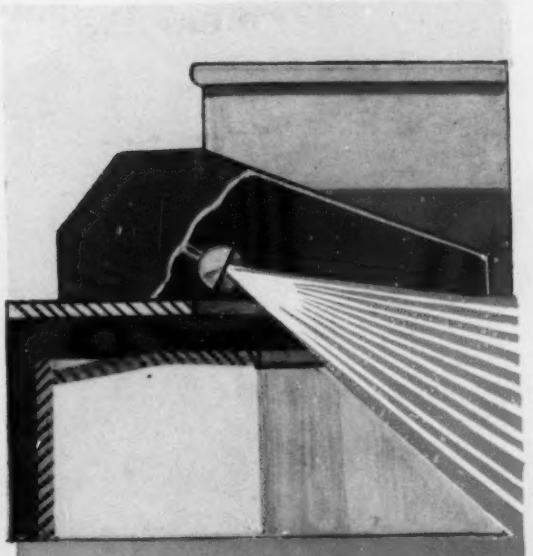
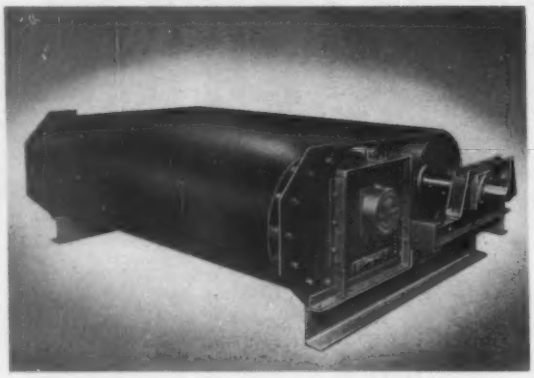
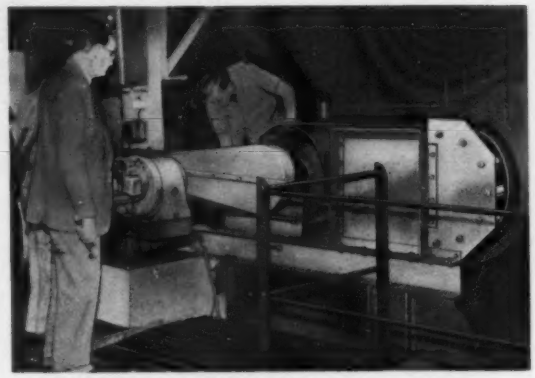


The oscillating jet nozzle position, indicating how possible water drips fall on to the basket top, not on to the spun sugar

# MAGNETIC CONVEYOR HEAD



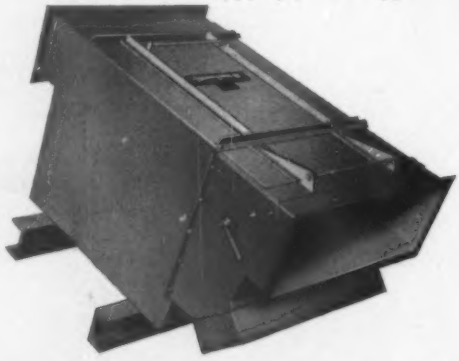
Boxmag patent MH. 2484. Conveyor Head built into an 84" wide short belt conveyor, photographed prior to despatch. The machine is designed for installation, as shown on the adjacent illustration.



Boxmag patent MH. 2484 installed in the chute between a sugar cane carrier and crusher, at a factory in Mauritius. It is designed to remove tramp metal automatically and continuously without an operator's attention. (write for leaflet 62/2).

# MAGNETIC SEPARATORS PROTECT MACHINERY AND PRODUCTS

**( Write for further details )**



Boxmag Superflux Magnetic Chute for removal of ferrous contamination from refined sugar to decontaminate the product.

A Boxmag Unimajor block type Permanent Magnet. One of the many types of separators suitable for general applications in sugar factories. (write for details of full range).

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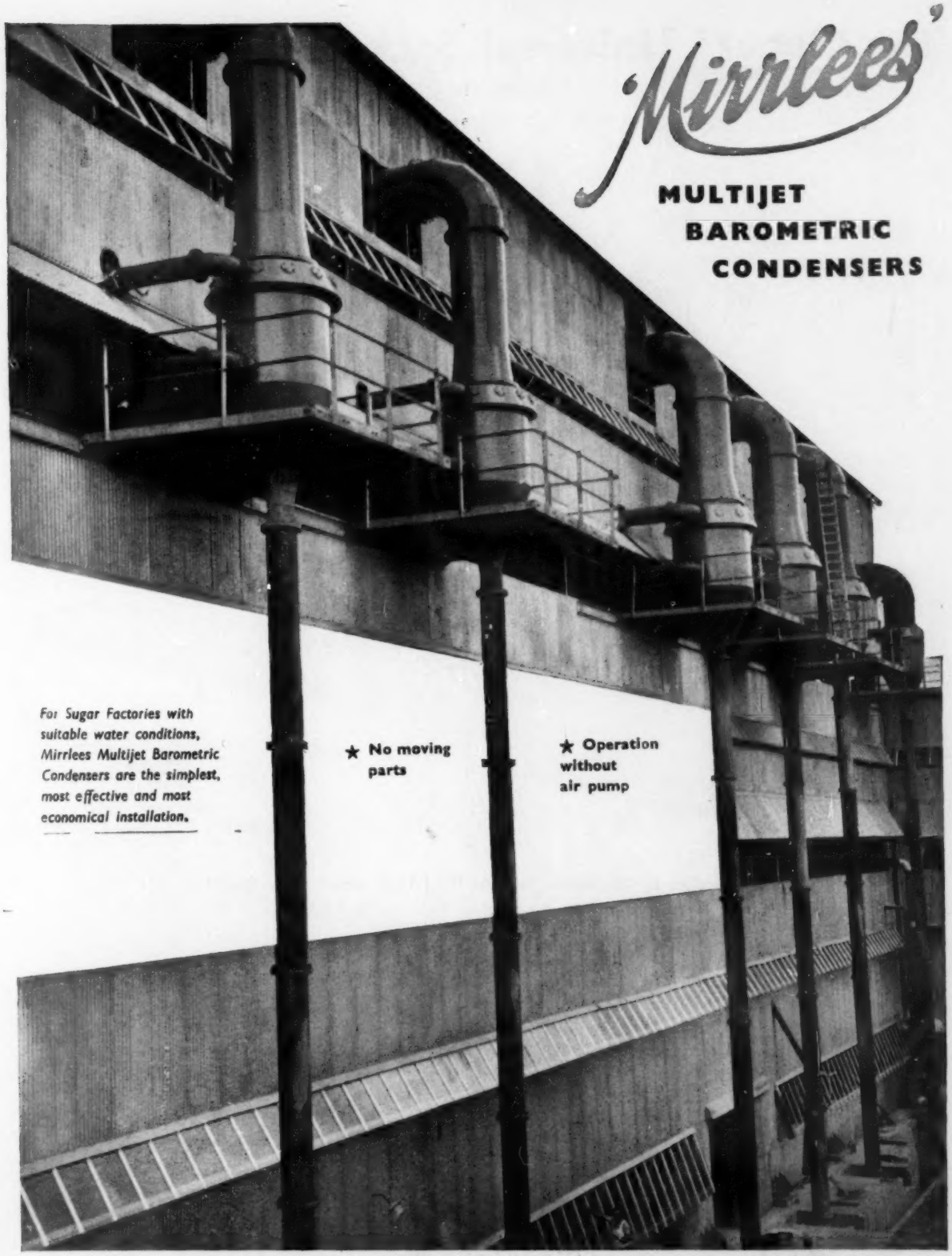
**MULTIJET BAROMETRIC CONDENSERS**



*For Sugar Factories with suitable water conditions, Mirrlees Multijet Barometric Condensers are the simplest, most effective and most economical installation.*

★ **No moving parts**

★ **Operation without air pump**

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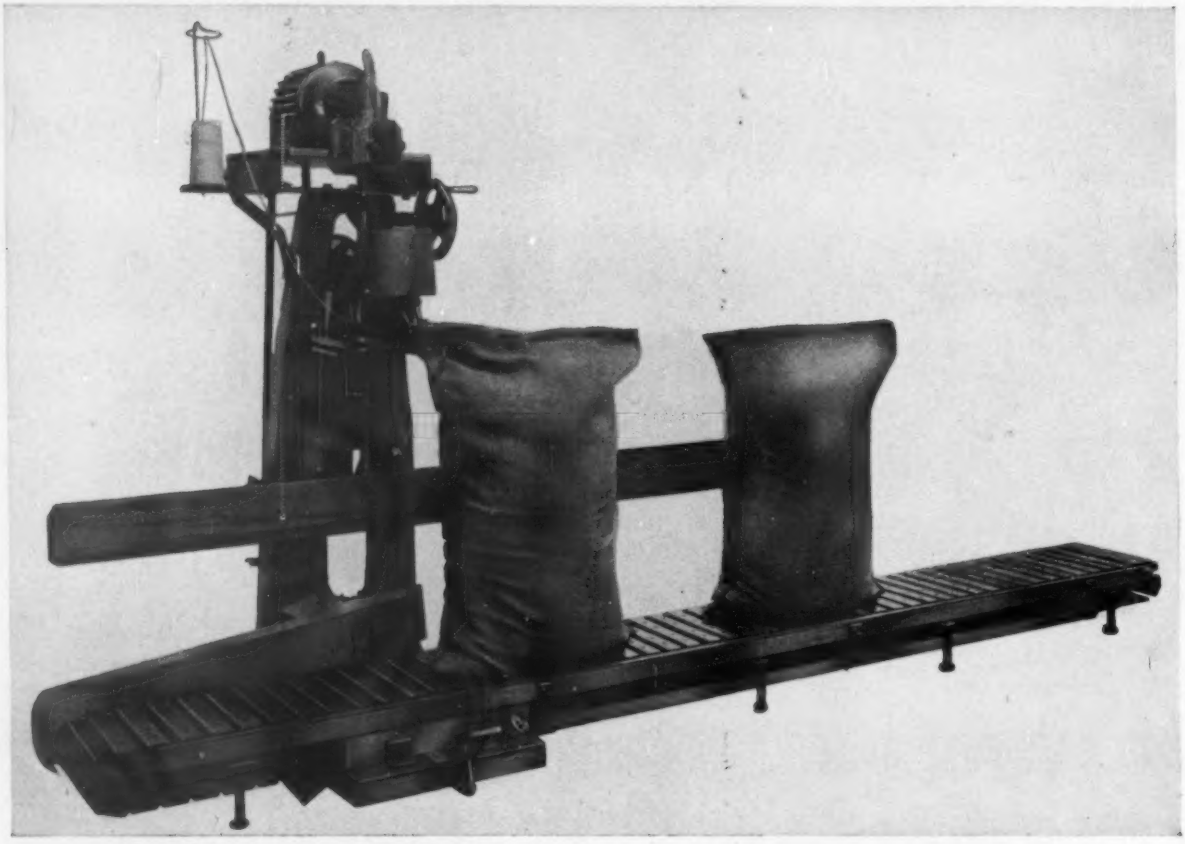
# The 'Super' Universal Sack Closing Machine

**MODEL NO. 5B**

*Fitted with 10 or 12 ft. Conveyor and Special Clutch Drive*



*This machine is fitted with a conveyor 10 or 12 ft. overall and a Special Clutch Drive which allows the conveyor to be run independently of the sewing head.*

*Jute, Hessian, Paper Lined Hessian, Cotton and Paper Sacks weighing from 50 to 325 lbs. can be sewn on this machine.*

*Machines can be seen working by appointment.*

*Power required 2 h.p.* *Shipping weight : 14 cwts.*

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**Manufactured in Great Britain by :**

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**(Timewell's Patent)**

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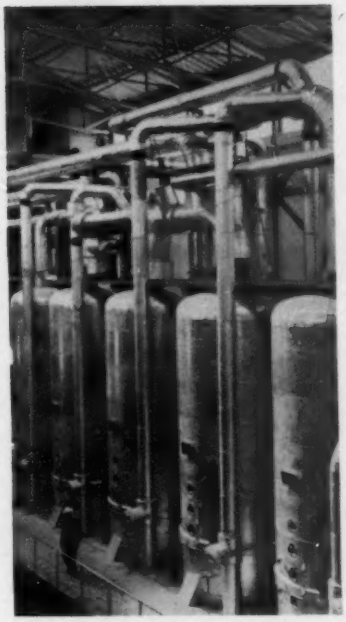
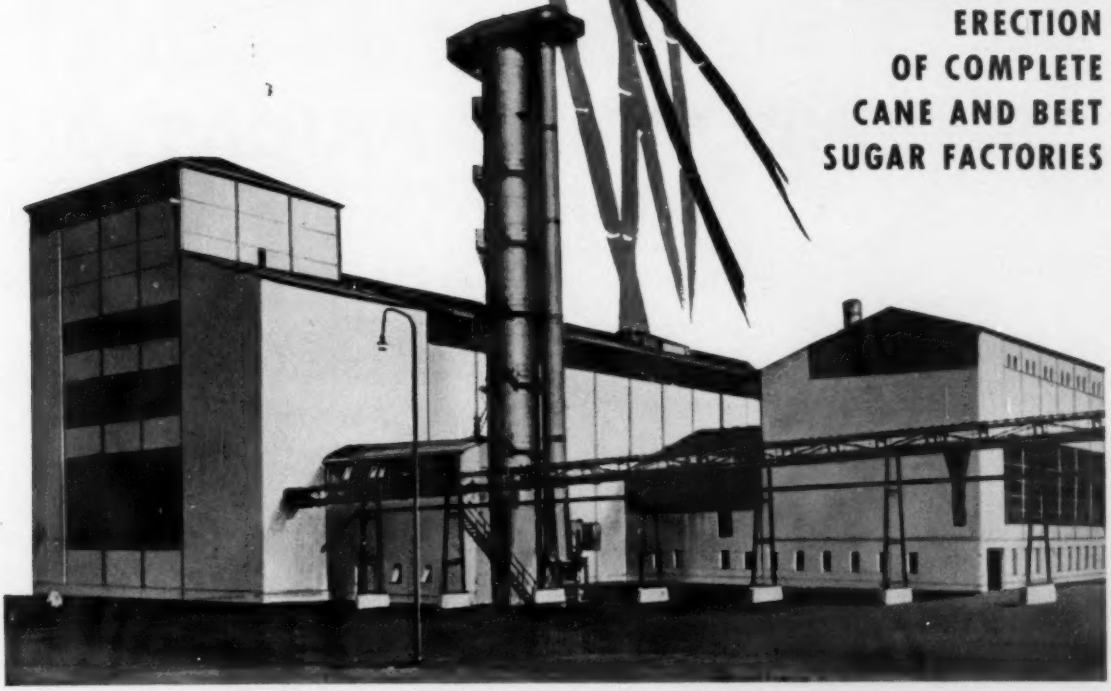


**PLANNING AND ERECTION OF COMPLETE CANE AND BEET SUGAR FACTORIES**

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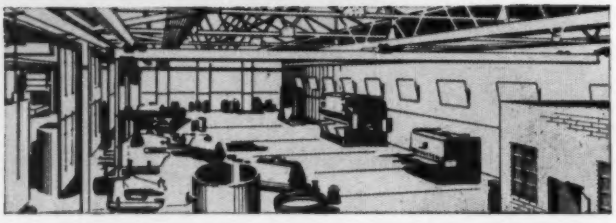
VORMALS: DEUTSCHE BERGWERKS- UND HUTTENBAU GESELLSCHAFT M.B.H.

SALZGITTER-DRUTTE / WESTERN GERMANY

*1,000 gall. kettle in ¼" copper. Lynx Quasi-arc welded.*

*Stainless steel vessel with mild steel jacket*

*12,000 gallon water separator*



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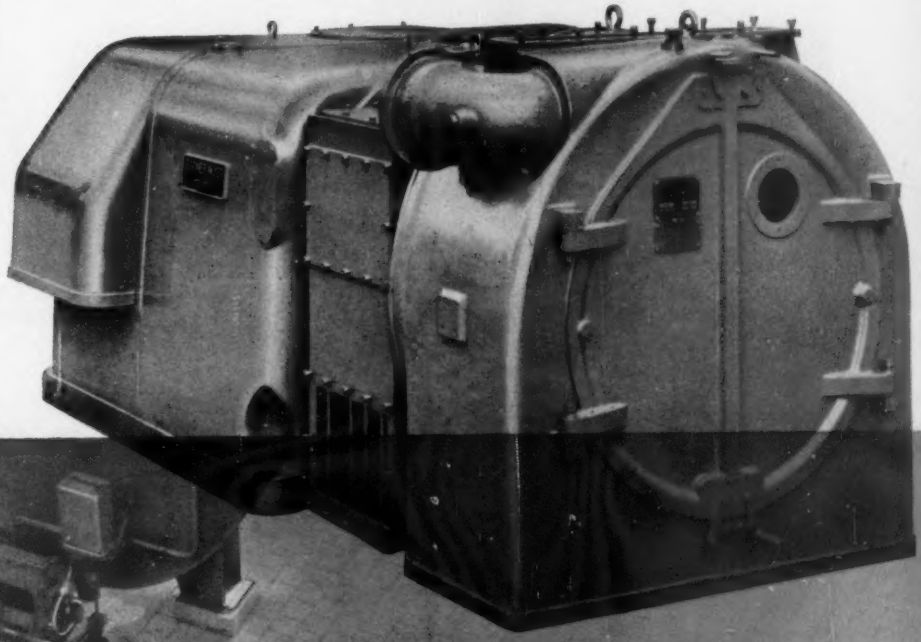
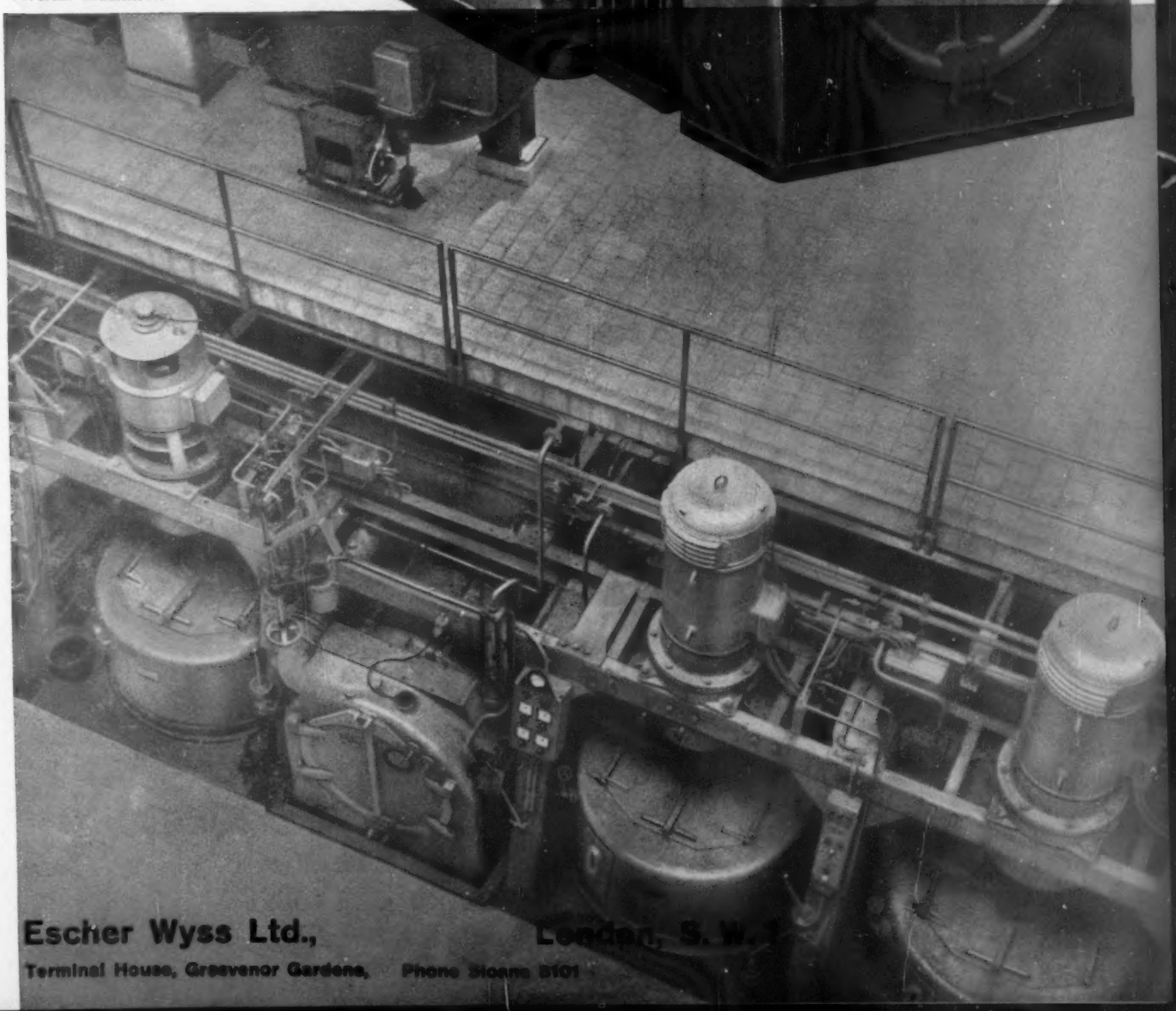
# ESCHER WYSS

## continuous centrifuges for the sugar industry

**These centrifuges are in operation at Sugar Factories throughout the world.**

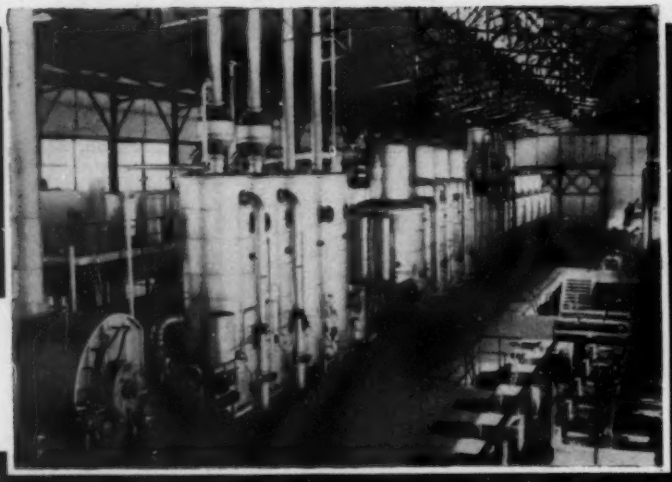


Escher Wyss Centrifuge as replacement in a battery of vertical machines.



**Escher Wyss Ltd.,** London, S.W.1

Terminal House, Grosvenor Gardens, Phone Sloane 8101

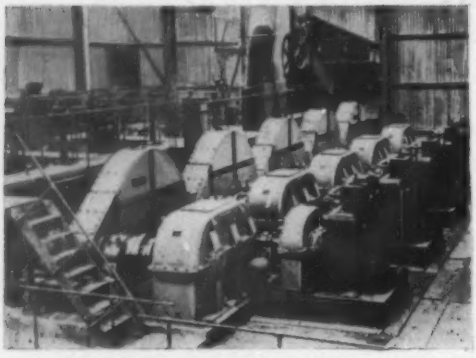


# WE

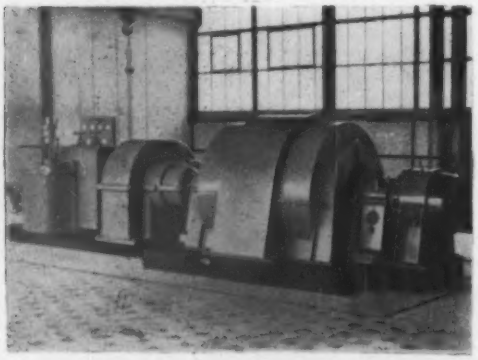
*can supply everything for your cane or beet*

## SUGAR FACTORY

Set of five 26" x 36" mills.
Urena sugar factory (Venezuela)



1800 kW turbo-alternator.
Malatya sugar factory (Turkey)



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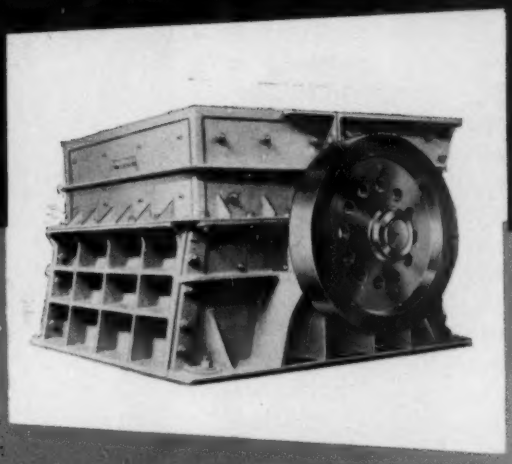
# THE GRUENDLER CANE SHREDDING PROCESS gives top performance ALL THE WAY . . . all over the world



- It increases sucrose extraction
- It increases capacity
- It lengthens roll life
- It produces better bagasse for fuel or paper-making
- And an additional and vital feature: . . . the design, engineering and construction of the Gruendler Cane Shredder prevents tramp metal from entering mill rolls where severe damage and costly shut-downs would result.

AN UNSOLICITED TESTIMONIAL IN GRUENDLER'S FILES STATES THE FOLLOWING:

"Because the shredder gives such a loud warning when tramp metal enters, the operator can remove the obstacle before it enters the mill tandem. We can sleep at night due to the elimination of worry from this score. If the shredder did nothing more than extract the iron from the mill we feel that this alone has paid for the entire shredder installation."

These men are holding a 190-lb. tyne from a crane grab that entered a Gruendler Shredder at Evan Hall Sugar Cooperative in Donaldsonville, La., U.S.A., but did not enter the mill! Mill maintenance is greatly reduced by the elimination of tramp iron such as this, which is very important in cane milling.

Photo shows an accumulation of tramp iron that entered the Gruendler Shredder at a mill in Peru. Any of these pieces could have been responsible for a long and costly shut-down of the mill.

## IT'S GOOD BUSINESS TO ADOPT THE GRUENDLER CANE SHREDDING PROCESS

**GRUENDLER CRUSHER & PULVERIZER CO.**

ESTABLISHED 1885

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Leo Freeman, V.P. Sugar Mill Div.
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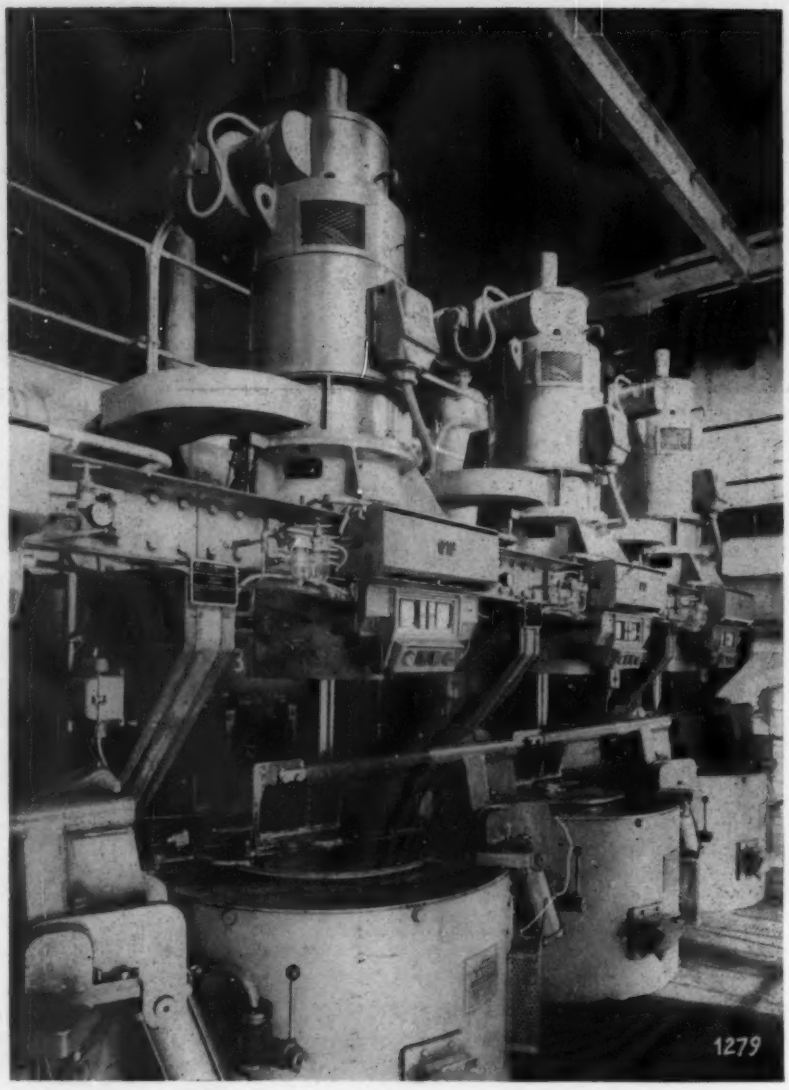
Since it was established in 1890, our Company has manufactured machinery for the sugar industry, and for more than forty years has specialized in constructing centrifugals.
Our Technical Service is continually developing machines which incorporate improvements designed to meet the technological requirements of new and varying processes in the sugar industry, taking into account the demands of the European Common Market. These new centrifugals are distinguished for their high grade of *standardization* and for their low cost both from the point of view of the purchase price and running costs.




# FULLY AUTOMATIC SUGAR CENTRIFUGALS

| *Type* | *Basket D × H* | *Basket cross section* | *Massecuite Max. Charge* | *Performances* | | |
|---|---|---|---|---|---|---|
| | | | | *Mod.* | *Max. sp. r.p.m.* | *Cycles per hr.* |
| "SCARA. U" | 1250 × 830 mm. | Cylindrical with truncated cone shaped bottom | 500 kg. | Normal | 1000 | 30 |
| | | | | Velox | 1500 | 25 |
| "SCAME. P" | 1050 × 585 mm. | Cylindrical with flat bottom | 350 kg | Normal | 1500 | 20 |
| | | | | Velox | 1800 | 10 |
| "SCAME. G" | 1220 × 762 mm. | Cylindrical with flat bottom | 650 kg. | Normal | 1000 | 25 |
| | | | | Velox | 1500 | 20 |

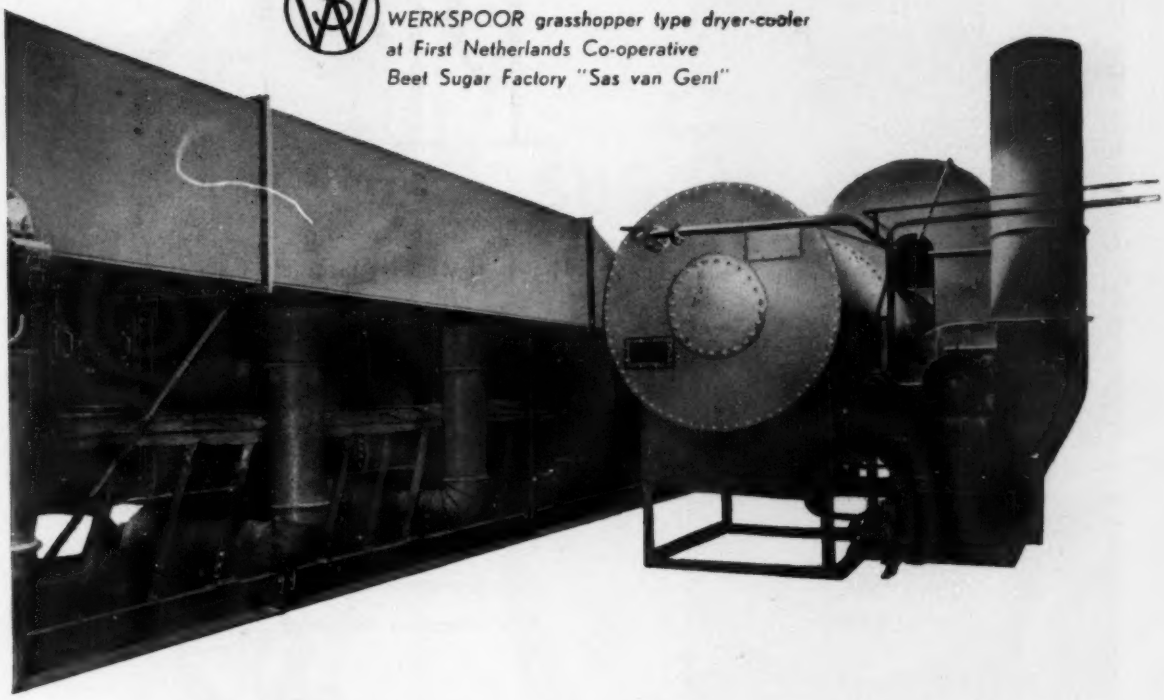
BOSCO TERNI

Officine Meccaniche e Fonderie

**A. BOSCO**

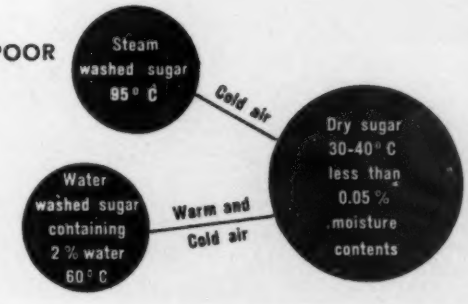
**TERNI** **ITALY**

*WERKSPOOR grasshopper type dryer-cooler at First Netherlands Co-operative Beet Sugar Factory "Sas van Gent"*



*This new* **WERKSPOOR** ***grasshopper type dryer-cooler keeps the lustre of your sugar***

**with its simple and low construction, economical working, built in any capacity you may require, this modern WERKSPOOR apparatus will guarantee you:**


Steam washed sugar 95° C
Cold air
Dry sugar 30-40° C less than 0.05 % moisture contents
Water washed sugar containing 2 % water 60° C
Warm and Cold air

- **absolutely undamaged crystals**
- **drying and cooling in record time**
- **close contact air-sugar**
- **completely dust free atmosphere**

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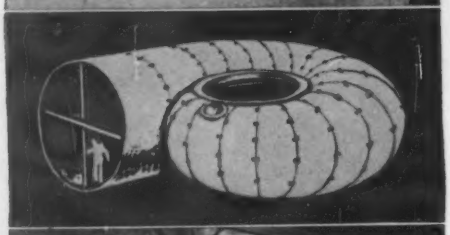
*For grasshopper type dryer-coolers please apply to Werkspoor, Amsterdam*

Baudouin



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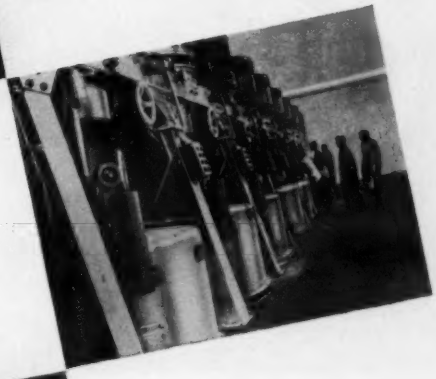

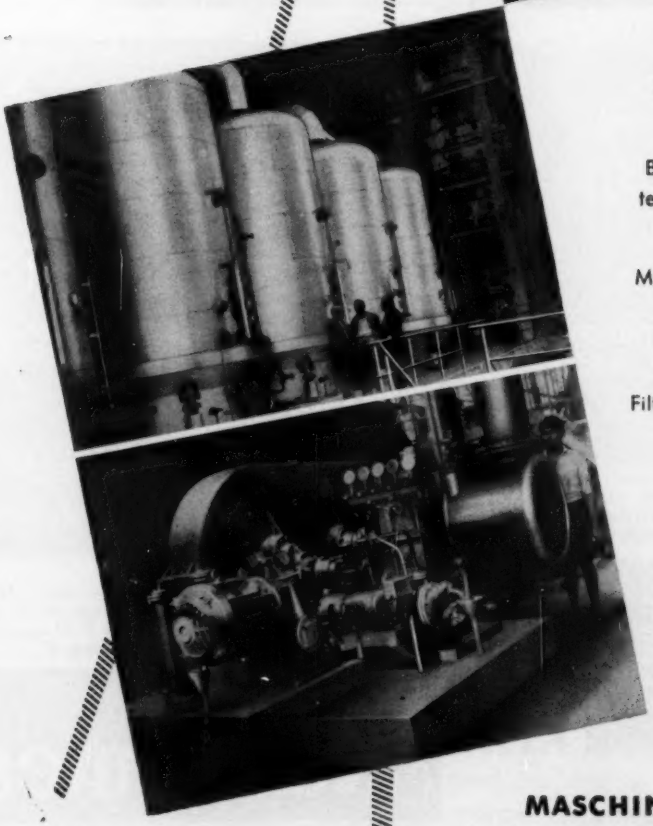

for the production of cane sugar up to highest grade refined sugar.

Basing on modern development in sugar technology we modernize plants of older design to obtain the highest economy.

Mill plants with single and group drive · Especially reconstruction of outdated mills · Centrifugal machines for white sugar, refined sugar, raw sugar. Filter plants suitable to solve all problems of filtration · Drying plants for the sugar industry · Power stations for all pressures and capacities.

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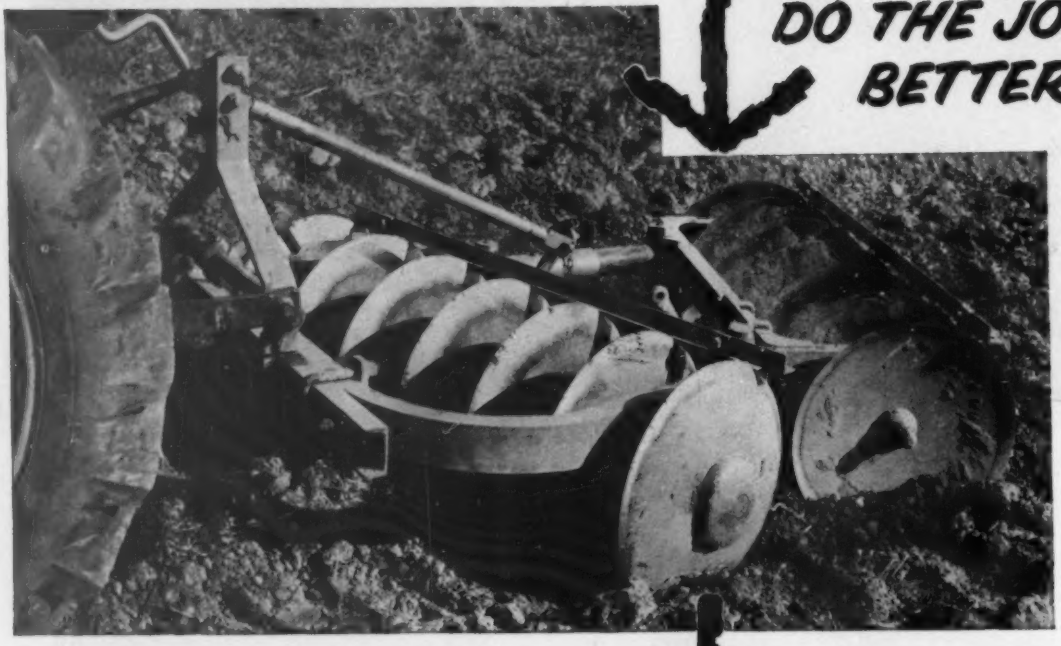
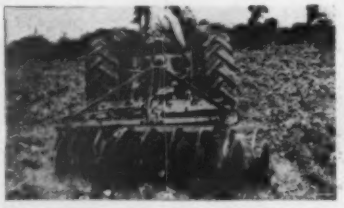
# Ransomes DISCS DO THE JOB BETTER!



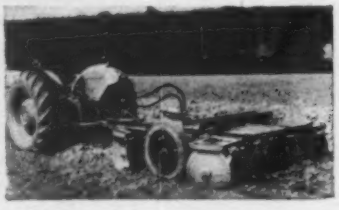
**THR 3002 (Mounted)** A heavy duty harrow which is ideal for working between rows about 6′ apart. 22″ Discs can be plain or cutaway, spaced 9″ apart, and gangs can be offset to right or left. Depth of work 8″.

**HR 20 (Mounted)**
An extremely well-balanced compact implement for cultivating over a width of 6′ 6″. Fitted with 18 discs, plain or cutaway, 20″ diameter, spaced 9″ apart. Easily offset to left or right. Depth of work 5″ to 6″.



**DUCHESS HR 21/2/3 (Trailed)**
An exceptionally strong implement made in sizes 7½′, 9′ and 10½′ wide, with discs, plain or cutaway, 24″ in diameter, and spaced 9″ apart. Drawbar has full range of adjustment and there are 6 alternative gang positions.

**VISCOUNT THR 1006/7 and 3001 (Trailed)**
Available with 24, 28 or 32 discs, 18″ or 20″ in diameter, plain or cutaway, spaced 6″ apart and cultivating 7″ deep. Hydraulically operated wheels lift the discs clear for transport.



With these modern well-designed implements Ransomes lead the way. All will do a first-class job in the conditions for which they are intended, and will give many years of useful life with the minimum expense. Write for illustrated literature of these and the complete Ransomes range of modern farm machinery including ploughs, cultivators, toolbars, ridgers, subsoilers, maize and peanut machinery, combine harvesters, driers, etc.

**THR 1005 (Mounted)**
A lighter harrow with 14 discs, plain or cutaway, 20″ diameter, spaced 9″ apart. Cultivating width 5′ 3″, or 7′ 3″ when offset to left or right. Depth of work 6″.

**Ransomes**

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**their long, specialised experience**
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The resources of Yorkshire Imperial Metals Limited are devoted solely to the manufacture of non-ferrous tubes, plates and fittings, and plastic tubes and fittings. They have long been intimately associated with the Sugar Industry, both at home and overseas, and have made a careful study of the varied and often arduous operating conditions which obtain in the Industry. This study has resulted in the development of improved tube and plate alloys, metallurgically designed and scientifically manufactured to give the best possible service. This unrivalled experience is at your service, free of charge and without obligation, to assist in the solution of problems of all kinds affecting the life and use of non-ferrous tubes and plates.

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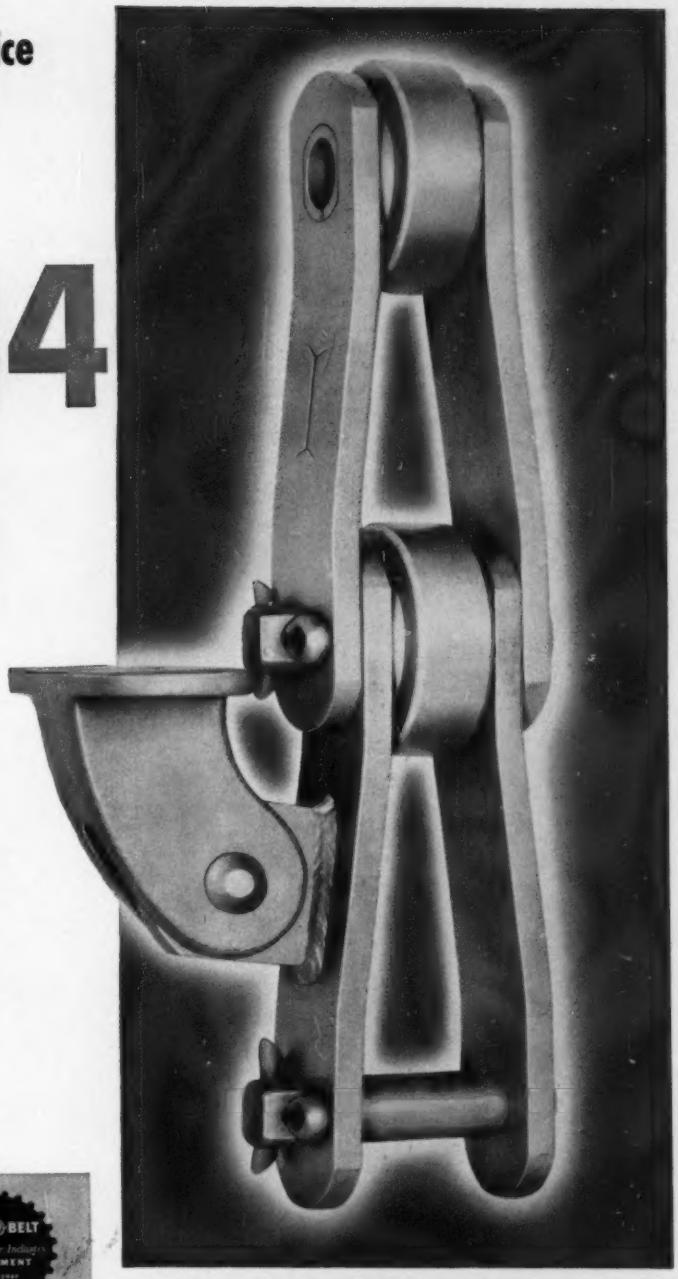
# SS-2184 PLUS

## CHAIN



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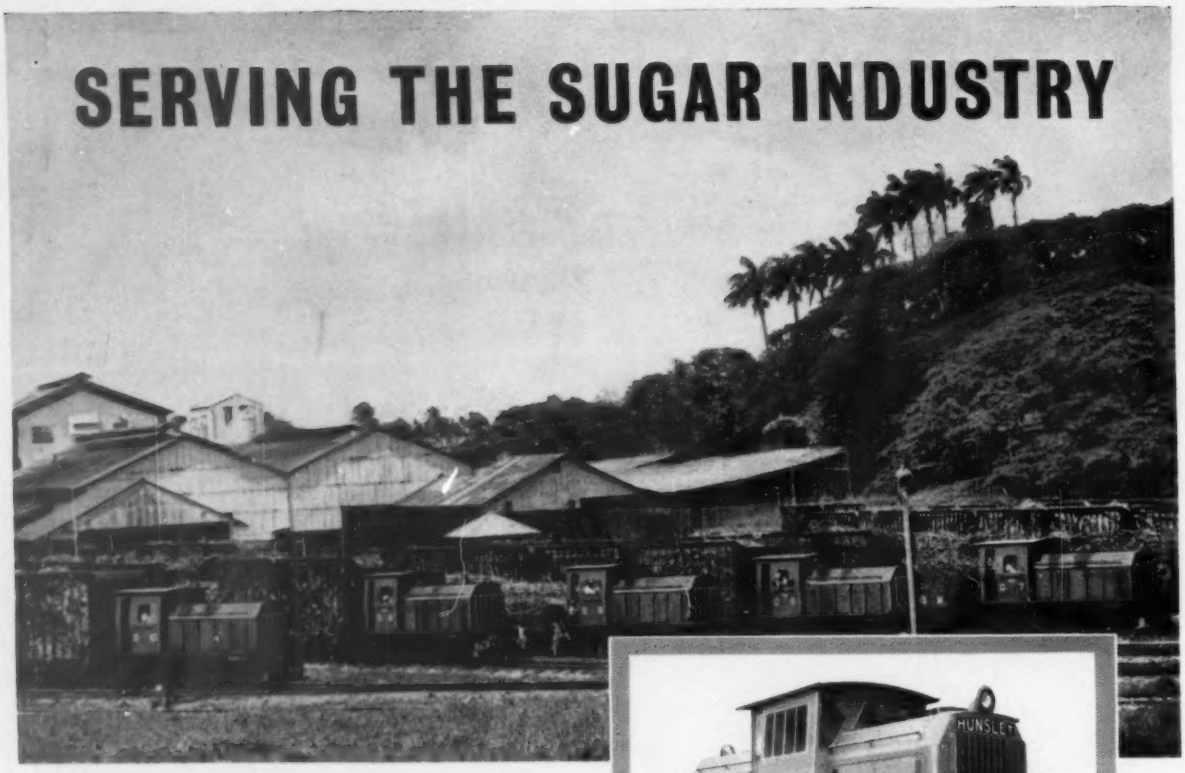
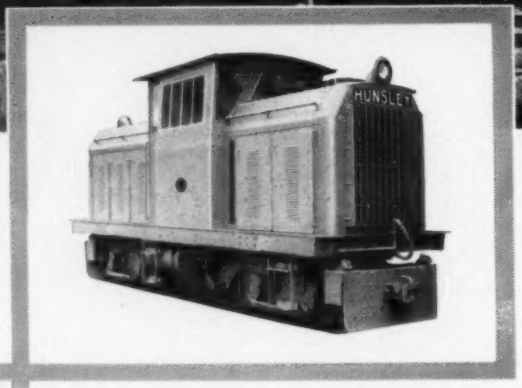


*A fleet of Hunslet 204 h.p. 0-6-0 type diesel locomotives on heavy sugar cane haulage duties on a sugar estate in the West Indies.*




230 *h.p. 'Articulated' diesel locomotive.*

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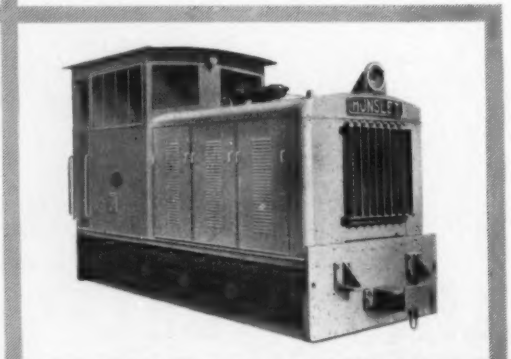
101 *h.p. 0-6-0 type diesel locomotive*

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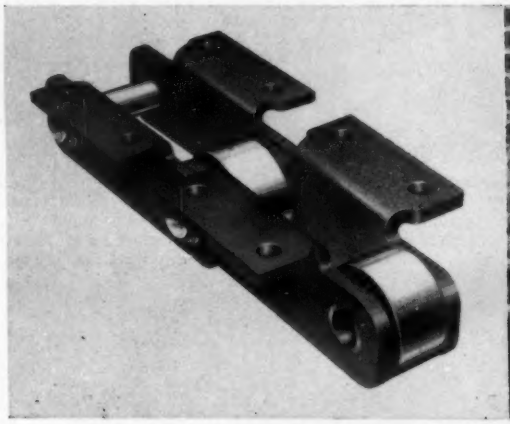

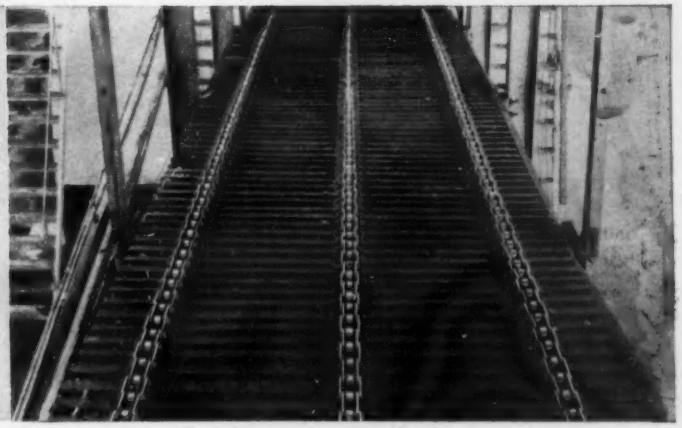

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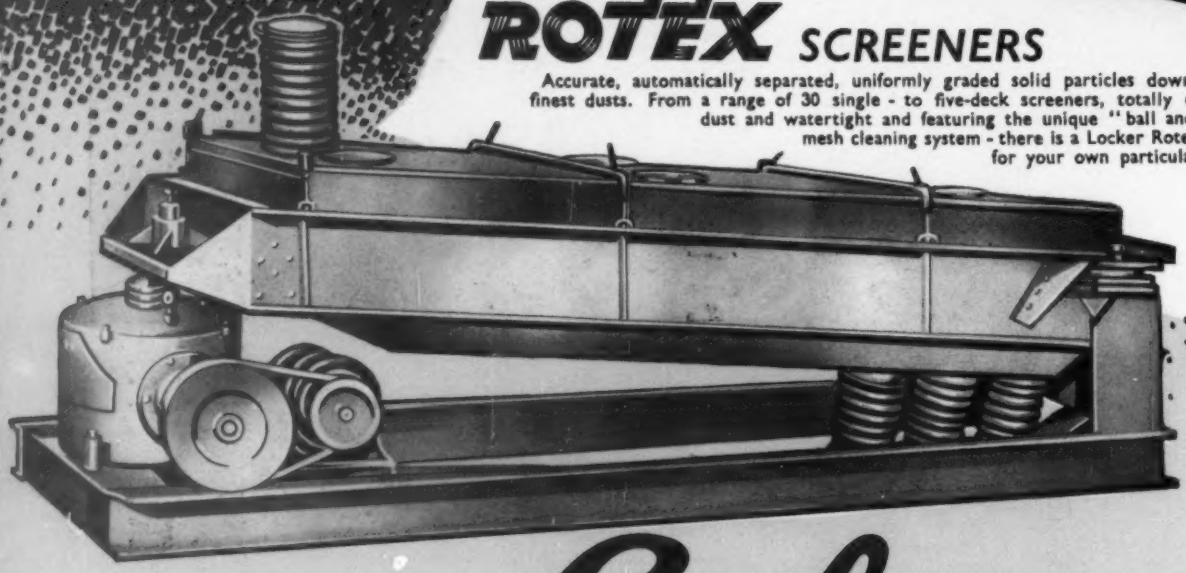

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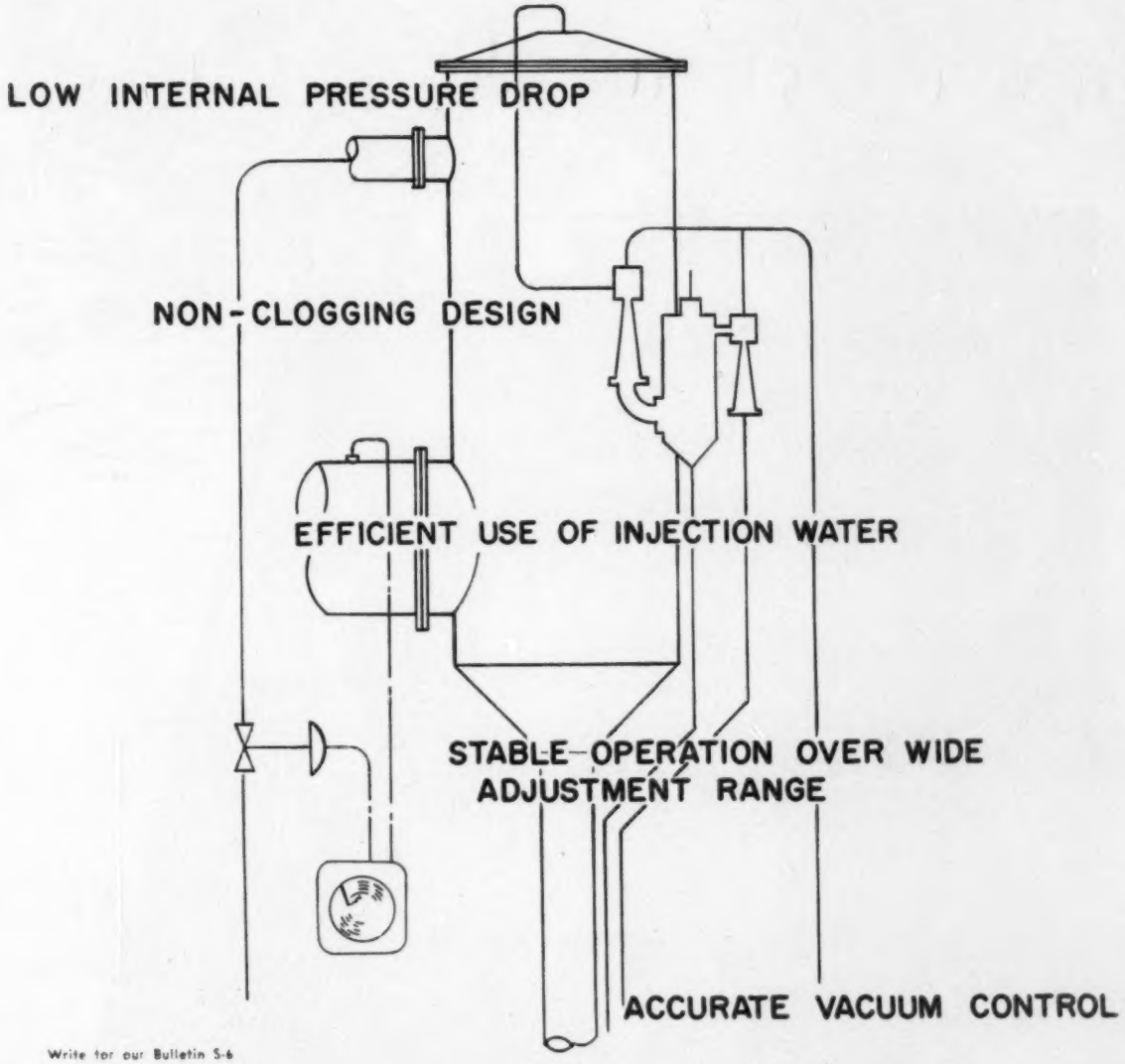
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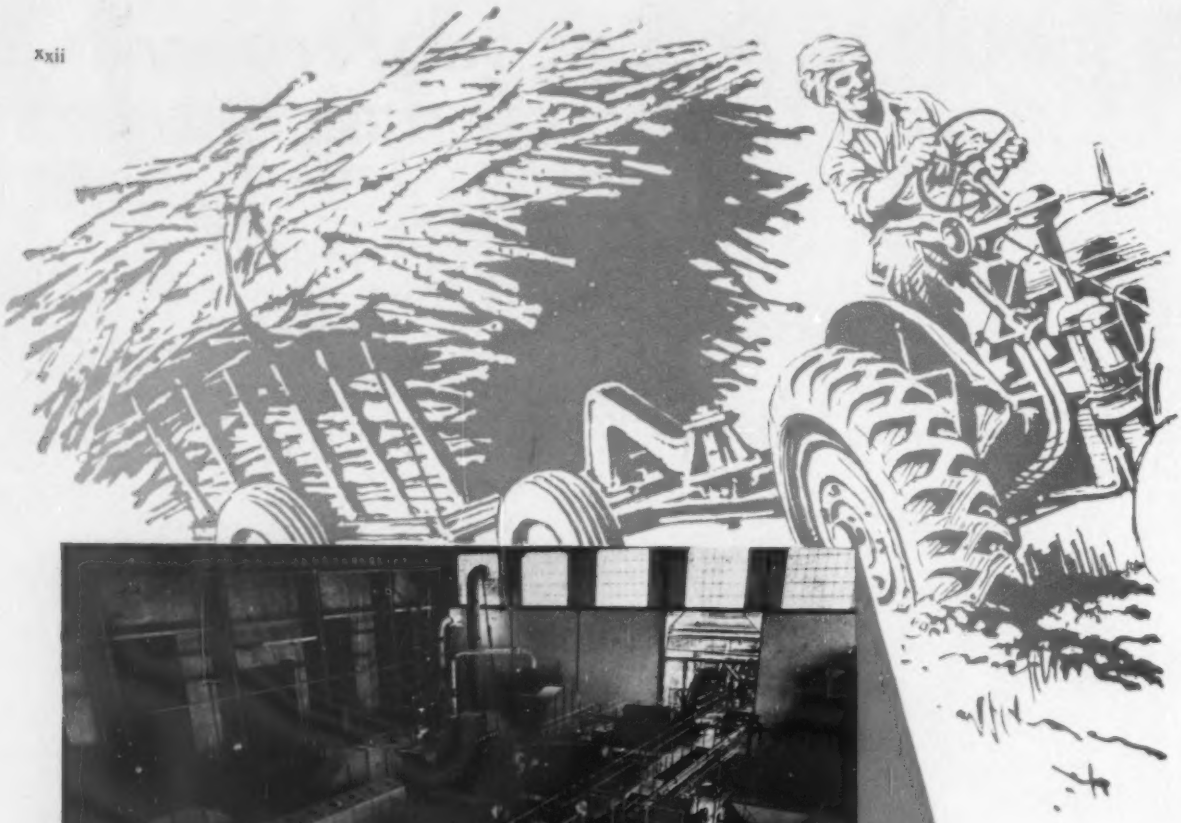

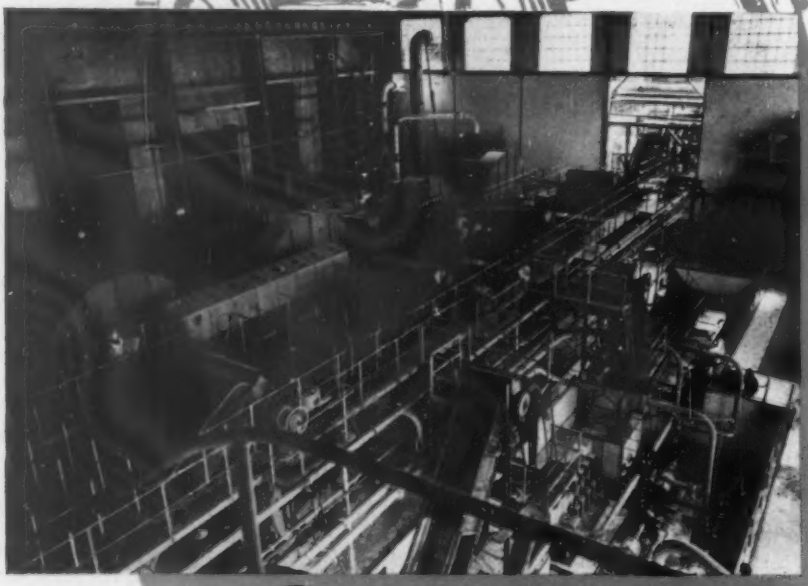

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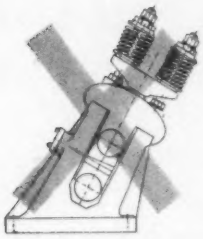
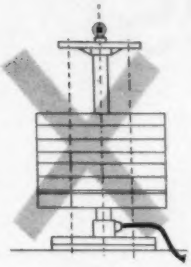
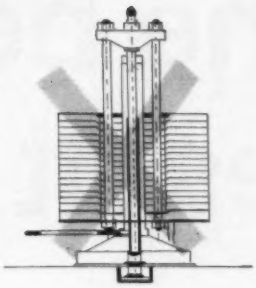


Spring or Toggle-Spring



Weight Accumulator



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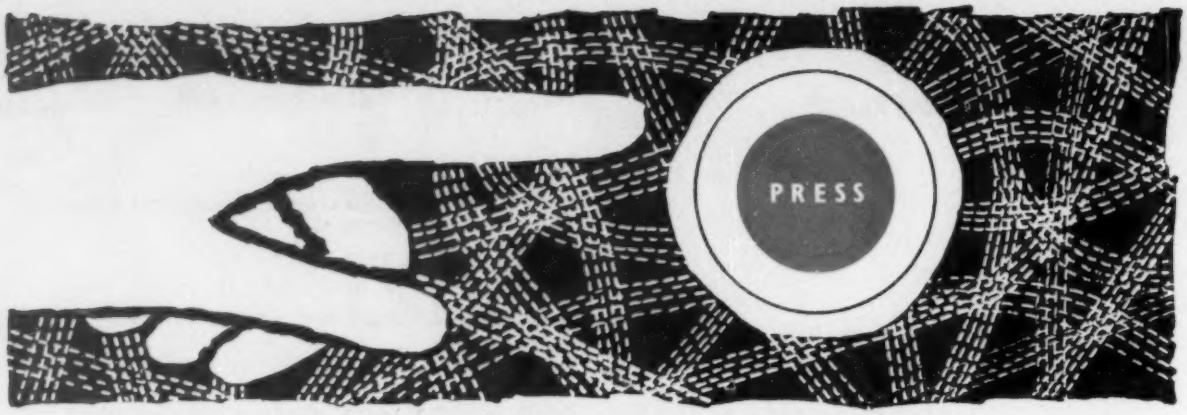


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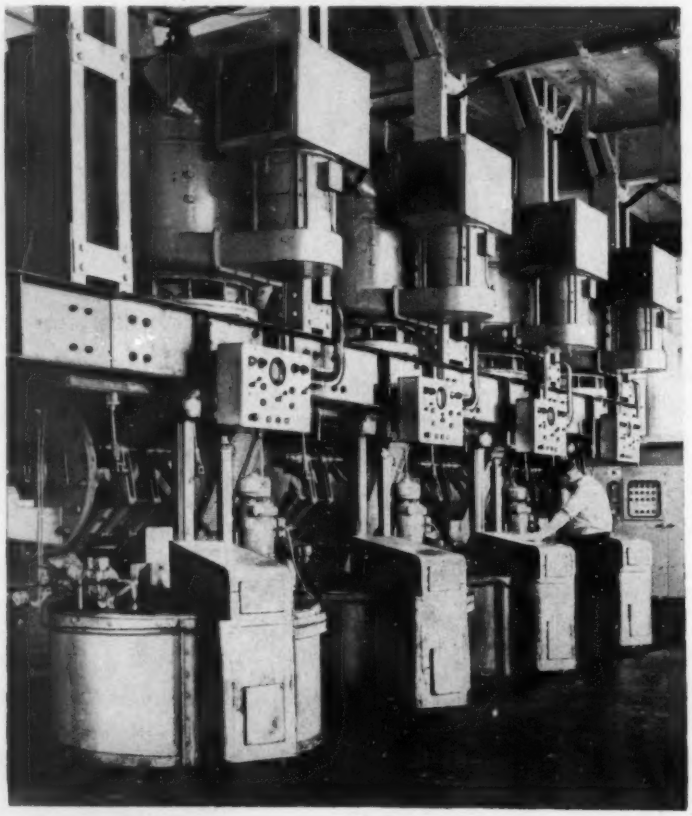

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THE
# INTERNATIONAL SUGAR JOURNAL

VOL. LXII OCTOBER, 1960 No. 742

## NOTES AND COMMENTS

**U.S. domestic sugar situation.**

It was mentioned in our last issue that part of the Dominican Republic's 1960 sugar quota, as increased by allotments of the various increases from July, had been withheld pending the outcome of the O.A.S. Meeting in Costa Rica. Following that meeting, President EISENHOWER sent a message to Congress reporting the unanimous condemnation of the Trujillo régime in the Dominican Republic and referred to the outstanding unpurchased quotas as a "large sugar bonus seriously embarrassing to the United States in the conduct of our foreign relations throughout the hemisphere".

The President therefore requested legislation to provide for diversion of the Dominican quota to other foreign countries without regard to allocation, and also asked for an extension of the current Sugar Act beyond its termination date of 31st March 1960.

After discussion in the House of Representatives and hearings by the House Agricultural Committee, a Bill was passed to the Senate providing for cutting of part or all of the quota only if the O.A.S. decided by 15th October to impose further economic sanctions, as well as restricting the cut (according to some interpretations[1]) to the amount beyond the Dominican Republic's basic quota of 131,000 short tons. The Bill also proposed an extension of the Act to 31st December 1961.

Strong opposition was met in the Senate, some Senators opposing any cuts while others wanted no limitations placed on the President's authority to impose the quota cut. No compromise could be reached and both Houses adjourned at the beginning of September until next January. This will leave only three months of the present Sugar Act to run, and trouble is consequently foreseen by Lamborn & Company.

According to Lamborn: "The Government, under the Sugar Act, is obliged to establish in December of this year its estimate of consumption requirements for 1961. When the Government establishes such consumption estimate for the year 1961, it will, because the sugar legislation ends on 31st March 1961, be obliged to establish a quota for only one-quarter of the year. This in itself will bring about dire complications. For example, refiners will not buy raw sugar for delivery subsequent to 31st March 1961. They may be confident that the Act will be extended by the new Congress in January but that will hardly justify their paying what would be a premium price for raw sugar if the Act is not extended.

"Further, in the procurement of raw sugar for melting purposes, U.S. refiners must know long in advance what their sources of supply are to be. They must anticipate their requirements and prepare for a steady flow of sugar. Time in transit is an important factor that must be taken into consideration. Transit time from the Philippines requires thirty to forty days, Brazil fifteen to twenty days, and Peru about twenty days. Again, the Philippines frequently market their sugars many months in advance—selling in December and January for April, May or June arrival. Uncertainties about the extension of the Sugar Act will paralyse that phase of the business.

"In the U.S. beet sugar industry, processors and growers would not be able, with confidence, to plan production and processing campaigns for the year of 1961. Then, too, the sales departments of the beet sugar processing companies can hardly plan intelligently the marketing of sugar on a short-term basis. Again, many industrial users of sugar base the selling price of the finished products, in part, on the cost of sugar—and this for many months in advance. Without some definite sugar programme this will be impossible.

"Without legislation that will continue the Sugar Act for a reasonable length of time great uncertainty will be created in the minds of all, leading to a highly erratic and unstable market. This would be quite contrary to the basic fundamentals of the Act."

* * *

**Flacq United Estates Ltd. Annual Report, 1959.**

In 1948, Flacq United Estates Ltd., (F.U.E.L.) was formed, merging into one Company the assets and liabilities of Cie. Sucrière de Bel Etang and Sans

[1] C. Czarnikow Ltd., *Sugar Review*, 1960, (472), 151.

Souci Ltd., Cie. de Queen Victoria Ltd. and of Union Flacq Sugar Estate Co. Ltd.

It was decided that all the canes hitherto crushed at the three different factories: (*a*) Sans Souci, (*b*) Union Flacq and (*c*) Queen Victoria would eventually be milled at Union Flacq.

By 1949, the centralization programme was well under way and in 1950 it was decided not to operate Sans Souci factory. Queen Victoria in its turn, ceased milling operations during the 1954 crop, and as from that year all the canes produced within F.U.E.L.'s factory area have been milled at Union Flacq.

In 1949 the total acreage of Estate's lands reaped by the Company was 6,846 acres; the yield per acre was 31·9 tons; the Estate's cane production was therefore 218,851 tons. The extraction for that year having been 11·99%, the yield of sugar per acre was 3·8 tons.

During the ten years that have elapsed since then, the Company has persistently improved its cultivation and has brought more land under cane cultivation and the following figures are those which relate to the 1959 crop:

| | |
|---|---|
| Total acreage reaped | 8,846 Acres |
| Total Estate's cane production .. | 316,678 Tons |
| Yield per Acre .. .. .. | 35·8 Tons |
| Extraction .. .. .. .. | 12·23% |
| Sugar per Acre .. .. .. | 4·37 Tons |

There is still a large acreage of land left for cane cultivation, which it is the intention of the Company to develop. The Company is now confident that in a not too distant future it will reap over 12,000 acres yearly. In fact, it will reap 9,546 acres in 1960, and 10,306 acres in 1961. If the extension is continued at that rate, by 1964 it will reach the target of over 12,000 acres.

*Tractors*—In 1949, the Company possessed 14 tractors, totalling 378 h.p., while as at the 31st December 1959, the Company had in operation a fleet of 23 tractors, totalling 2,354 h.p. Without such equipment it would not have been possible to work and cultivate lands which, before the introduction of the tractors of the most powerful type, were considered as marginal lands unsuitable for cane cultivation. It is simply remarkable how, after these lands have been worked and grown in canes, they have proved to be good and fertile soil easily arable and cultivable.

*Transport*—At the time of the formation of the Company nearly 65% of the canes received in the Company's factory yards were transported by tramways and the total length of the Company's railway system was approximately 182 miles. The Company has, more particularly during the recent years, gradually replaced rail transport by road transport wherever feasible. By the end of 1959 the total length of the Company's railway system had been reduced by 25 miles which had been scrapped. During this crop year, out of 563,492 tons of canes received in the factory yard, 24·4% were delivered by rail and 75·6% by road vehicles.

In 1959, the Company purchased three "Hilo" trailers of 15 tons capacity, each drawn by an Atkinson mechanical horse powered by a Rolls-Royce engine of 150 h.p.

*Cane handling*—Cane handling in the factory yard was, as from 1950 up to the end of 1957, performed by two derricks, one of 100 feet radius and 11 tons capacity and the other of 60 feet radius and 5 tons capacity. At the end of the 1957 crop, the Company sold the 5 tons derrick which was replaced by two ASEA overhead cranes of 15 tons capacity each travelling on a gantry having a span of 120 feet. These cranes, which are probably the largest in the sugar world, have performed excellent work during the two last crops in speeding up transport and will undoubtedly be invaluable when more "Hilo" trailers are in operation.

*Factory*—In 1949 the milling capacity of Union Flacq's factory was 60 tons per hour and its total sugar output was 14,436 tons.

By 1950, the year of the first centralization, two sets of cane knives and a new mill train consisting of 4 mills of Cail make, driven by two reciprocating steam engines, had been installed. Among other improvements a 30 ton watertube high pressure Cail boiler was installed; a power house had been built and equipped with a 1500 kW Breguet turbo alternator. The vacuum pans capacity was increased to 270 tons, etc.

During the years following 1950, two new Cail boilers of the same capacity and a new turbo alternator of the same make and capacity, two new mills (one of which is driven by a Worthington steam turbine) were installed, the electric engines driving the two sets of cane knives were replaced by two Worthington steam turbines; a new evaporating set of 45,000 sq. ft. was purchased and installed; the vacuum pans capacity had been increased to 310 tons and the centrifugals station had been reinforced by the addition of four Broadbent centrifugals.

Then, in the course of 1959, the Company took one more step forward and made very extensive additions and developments to the Factory as described previously[1].

During the 1959 crop Union Flacq factory milled 563,492 tons of cane at the rate of 206·4 tons per hour. The mill extraction was 96·3 with a fibre content of 11·13 (which equals a reduced mill extraction of 95·8 with a standard fibre content of 12·50). The losses were 1·56 and the total sugar produced was 68,920 tons.

This last figure exceeds by over 12,000 tons the previous record which had been established in 1958 with 56,697 tons of sugar.

[1] *I.S.J.*, 1959, **61**, 320.

# STUDIES ON THE SUGAR CANE SMUT IN TUCUMÁN

By Dr. WILLIAM E. CROSS

## PART II

*The effect of the smut on the production of cane*

In view of the severity of the smut attack on the principal varieties cultivated in Tucumán up to 1944, i.e. the POJ 36, POJ 213, Tuc. 472 and the Tuc. 1376, these canes were dropped out of commercial cultivation. But when the private experimental farm of the factory owners was established in 1947, I planted them in a number of plots in order to be able to observe closely the effect of the disease, especially on the production and the quality of the canes. In these plots I also planted immune, presently commercial varieties, such as Tuc. 1149, Tuc. 2645 and Tuc. 2680, as "checks".

In these experiments, in the year of plant cane, the degree of attack was very slight, but in each of the stubble years a large percentage of the shoots were killed off. Nevertheless, the production of cane and sugar obtained during these years was, under the circumstances, surprisingly good, as is shown by the average annual data which are given in Table II.

It is interesting to note that in some cases these canes, in spite of the heavy damage they suffered from the smut, actually produced more cane and sugar per hectare than the commercially cultivated varieties, which are immune to the disease, which we employed as "checks". This can be observed in the plots C2 and C4, where the Tuc. 1376 gave much better yields than the Tuc. 1149, and in the plot V8 where that same cane was much more productive than the Tuc. 2680—and also in the plot V7, where the Tuc. 472 was better than the Tuc. 2645.

The results in Table II include those of the harvest of 1954. The plots, with the exception of C4 and V8, continued to be cultivated until the crop of 1956, but in the last two years we were unable to obtain data on the percentage of stalks destroyed by the smut. It is nevertheless interesting to give the production data of the old stubble plots in the harvest of 1956, which are presented in Table III.

The long life of these stubbles, and their continued productivity, in spite of the cane being severely attacked by the smut in each year, is very striking. We attribute it to the fact that the canes attacked, at the same time as they suffer the destruction of the young stalks, usually throw out more shoots, many of which remain free from attack and develop more rapidly than do usual healthy canes. Thus in a variety of cane which has suffered the destruction of many stalks, the total number of shoots produced is much greater than was usual in the same variety when it

**Table II**

**Yields obtained from stubble cane highly infected with smut (Average annual data)**

| *Variety* | *Plot* | *Stubble years* | *Stalks destroyed by smut per 100 metre row* | *Percentage of total stalks produced, destroyed by smut* | *Kilos of cane produced per hectare* | *Factory yield %* | *Kilos of sugar produced per hectare* |
|---|---|---|---|---|---|---|---|
| POJ 36 | C2 | 1st–6th | 1818 | 62 | 33,700 | 8·54 | 2,280 |
| | C4 | 1st–4th | 1692 | 63 | 25,500 | 7·68 | 1,958 |
| | C5 | 1st–5th | 1497 | 58 | 24,800 | 9·56 | 2,366 |
| | V10 | 1st–5th | 1923 | 66 | 40,000 | 9·75 | 3,900 |
| POJ 213 | C2 | 1st–6th | 261 | 15 | 40,200 | 9·00 | 3,618 |
| | C4 | 1st–4th | 118 | 6 | 48,000 | 8·10 | 3,888 |
| | C5 | 1st–5th | 225 | 8 | 56,300 | 9·01 | 5,072 |
| | V11 | 3rd–5th | 441 | 17 | 44,000 | 9·22 | 4,057 |
| Tuc. 472 | C2 | 1st–6th | 101 | 4 | 54,000 | 8·40 | 4,536 |
| | C4 | 1st–4th | 51 | 2 | 46,000 | 8·46 | 3,892 |
| | C5 | 1st–5th | 131 | 4 | 52,800 | 9·82 | 5,185 |
| | V7 | 2nd–6th | 707 | 18 | 54,700 | 9·46 | 5,174 |
| Tuc. 1376 | C2 | 1st–6th | 1590 | 33 | 86,600 | 7·92 | 6,860 |
| | C3 | 1st–6th | 1055 | 29 | 65,600 | 10·14 | 6,652 |
| | C4 | 1st–4th | 1343 | 32 | 70,300 | 7·83 | 5,506 |
| | C5 | 1st–5th | 1561 | 33 | 93,400 | 8·59 | 8,023 |
| | V8 | 1st–6th | 882 | 22 | 84,500 | 9·07 | 7,664 |
| Tuc. 1149 (*check*) | C2 | 1st–6th | 0 | 0 | 80,700 | 7·87 | 6,350 |
| | C4 | 1st–4th | 0 | 0 | 62,600 | 7·38 | 4,620 |
| | V10 | 1st–5th | 0 | 0 | 68,600 | 9·08 | 6,228 |
| | V11 | 3rd–5th | 0 | 0 | 69,100 | 8·66 | 5,984 |
| Tuc. 2645 (*check*) | V7 | 2nd–6th | 0 | 0 | 53,500 | 9·45 | 5,056 |
| | V10 | 1st–5th | 0 | 0 | 90,180 | 9·86 | 8,894 |
| | V11 | 3rd–5th | 0 | 0 | 58,800 | 10·40 | 6,117 |
| Tuc. 2680 (*check*) | V8 | 1st–6th | 0 | 0 | 71,500 | 8·36 | 5,980 |
| | V10 | 1st–5th | 0 | 0 | 87,600 | 8·35 | 7,312 |
| | V11 | 3rd–5th | 0 | 0 | 52,800 | 8·93 | 4,721 |

**Table III**

**Yields obtained in the harvest of 1956, from old stubbles of cane severely attacked by smut**

| *Variety* | *Plot* | *Stubble year* | *Date of harvest* | *Kilos of cane produced per hectare* | *Factory yield %* | *Kilos of sugar produced per hectare* |
|---|---|---|---|---|---|---|
| POJ 36 | C2 | 8th | August 16th | 20,000 | 10·83 | 2,166 |
| | C5 | 7th | September 18th | 23,200 | 10·95 | 2,540 |
| | V10 | 7th | June 5th | 9,700 | 7·94 | 770 |
| POJ 213 | C2 | 8th | August 15th | 30,000 | 11·26 | 3,369 |
| | C5 | 7th | September 18th | 41,100 | 11·18 | 4,595 |
| | V11 | 7th | July 7th | 25,900 | 9·21 | 2,385 |
| Tuc. 472 | C2 | 8th | August 15th | 29,000 | 10·19 | 2,955 |
| | C5 | 7th | September 18th | 54,300 | 10·93 | 5,935 |
| | V7 | 8th | August 6th | 63,200 | 10·72 | 6,775 |
| Tuc. 1376 | C2 | 8th | August 15th | 54,000 | 10·64 | 5,746 |
| | C3 | 8th | August 13th | 49,000 | 10·49 | 5,140 |
| | C5 | 7th | September 18th | 107,700 | 12·89 | 13,880 |
| Tuc. 1149 (*check*) | C2 | 8th | August 16th | 77,000 | 11·05 | 8,508 |
| | V10 | 7th | June 8th | 61,500 | 7·75 | 4,766 |
| | V11 | 7th | July 11th | 72,300 | 7·44 | 5,379 |
| Tuc. 2645 (*check*) | V7 | 8th | August 4th | 55,700 | 11·42 | 6,361 |
| | V10 | 7th | June 5th | 57,900 | 8·23 | 4,759 |
| | V11 | 7th | July 11th | 26,400 | 8·93 | 2,592 |
| Tuc. 2680 (*check*) | V10 | 7th | June 7th | 84,100 | 8·09 | 6,807 |
| | V11 | 7th | July 10th | 25,600 | 8·92 | 2,280 |

was free from smut. This is shown by the following data obtained from the results of a large number of observations.

**Average total number of stalks produced per hundred metre row, including those destroyed by the disease**

| *Variety* | *Before* 1943, *when the cane was free from smut* | *In recent years, when the cane is severely attacked by smut* |
|---|---|---|
| POJ 36 | 1,500 | 3,000 |
| Tuc. 472 | 2,300 | 3,500 |
| Tuc. 1376 | 2,700 | 4,000 |

It is due to this property of the smut-attacked canes, of throwing out more shoots, that they can give good crops even when they lose a large number of stalks destroyed by the disease. A notable case of this kind is that of the Tuc. 1376, which in the past few years, in spite of the fact that it has been severely attacked by smut, has given higher average yields than it did before 1943, when it was free from the disease, these yields being now approximately equal to those of the commercially grown immune varieties, which up to 1943 were definitely the more productive. This is shown by the following average annual data from our very numerous experimental plots[4] (Table IV).

**Table IV**

**Comparative production of the smut-susceptible Tuc. 1376, and the immune varieties Tuc. 2645, Tuc. 2680 and Tuc. 2683, in the years before the smut existed in Tucumán, and in the past ten years, when the Tuc. 1376 has been severely attacked**

| *Period* | *Variety* | *Kilos of cane produced per hectare* | *Factory yield %* | *Kilos of sugar produced per hectare* |
|---|---|---|---|---|
| 1933-1942 | Tuc. 1376 | 73,880 | 8·97 | 6,625 |
| | Tuc. 2645 | 91,667 | 9·17 | 8,409 |
| | Tuc. 2680 | 115,556 | 8·62 | 9,958 |
| | Tuc. 2683 | 86,444 | 9·37 | 8,100 |
| 1947-56 | Tuc. 1376 | 81,717 | 8·71 | 7,118 |
| | Tuc. 2645 | 75,638 | 9·44 | 7,137 |
| | Tuc. 2680 | 78,603 | 8·96 | 6,998 |
| | Tuc. 2683 | 83,362 | 8·68 | 7,235 |

*The effect of the smut on the factory yields of the cane*

Many people believe that the cane cropped from smut-infected fields gives low factory yields, but our experience shows that this is not the case in Tucumán. The average results shown in Table II, for example, indicate that in every case the severely attacked susceptible varieties were richer in sugar than the immune, commercially grown canes Tuc. 1149 and Tuc. 2680, which were cultivated in the same plots as "checks"—and also that, even in comparison with the Tuc. 2645, one of our sweetest canes, in plot V7, the Tuc. 472 practically equalled it in sugar

**Table V**

**Ratios between the factory yields of susceptible varieties, and those of immune varieties, grown in the same plots, respectively, before and after the smut invasion**

| *Variety* | *Average factory yields %* *Period* 1943-1942 *(all canes free from smut)* | *Period* 1947-54 *(susceptible canes severely attacked)* |
|---|---|---|
| POJ 36 | 9·16 | 8·72 |
| Tuc. 1149 | 9·00 | 8·15 |
| Ratio | 1·0178 | 1·0700 |
| POJ 36 | 9·08 | 8·60 |
| Tuc. 1406 | 9·49 | 8·43 |
| Ratio | 0·9568 | 1·0202 |
| POJ 36 | 8·69 | 9·75 |
| Tuc. 2645 | 9·17 | 9·86 |
| Ratio | 0·9477 | 0·9888 |
| POJ 36 | 8·79 | 9·75 |
| Tuc. 2680 | 8·62 | 8·35 |
| Ratio | 1·0197 | 1·1677 |
| POJ 213 | 8·55 | 9·12 |
| Tuc. 1406 | 9·00 | 8·43 |
| Ratio | 0·9500 | 1·0819 |
| Tuc. 1376 | 8·97 | 8·54 |
| Tuc. 1406 | 9·49 | 8·77 |
| Ratio | 0·9452 | 0·9738 |

[4] In first period, in Tucumán Experiment Station; in second period, in private experimental farm of the factory owners, San Pablo, Tucumán.

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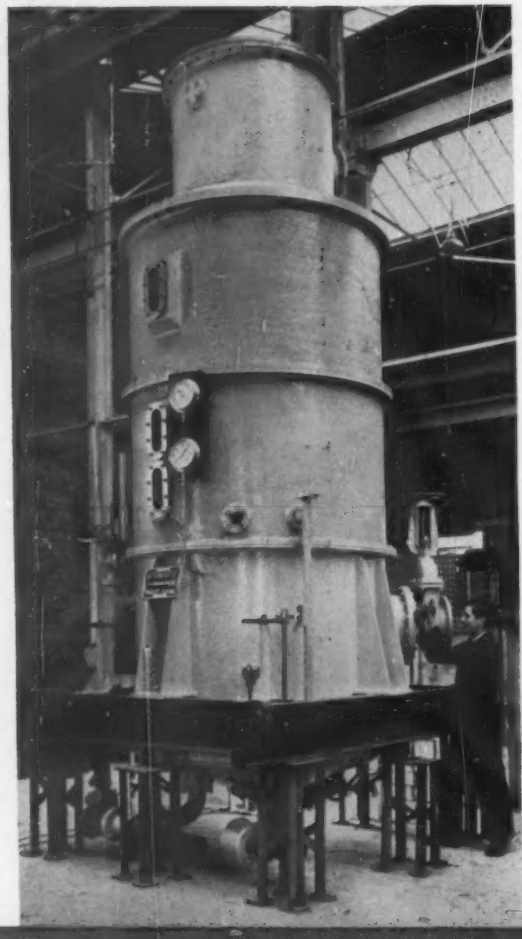

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yield. This superiority in the factory yields of these varieties made it appear possible that the smut has the effect of increasing the sugar content of the cane. In an endeavour to determine whether this is true, we have studied the ratios between the factory yields of susceptible varieties, and those of immune commercial canes grown in the same experimental plots, which existed before the smut appeared here, and which have prevailed in the past few years, when the susceptible canes have been severely infected. The results of this study are given in Table V.

These data would appear to indicate that the susceptible varieties, now that they are severely attacked by the smut, are relatively richer in sugar in comparison with the immune canes, than they were before the disease appeared in this country.

*Methods of Control*

In our opinion by far the best way to control the smut is to cultivate only varieties which are practically immune to the disease. When it entered this country we were taken unawares, but we quickly discovered that fortunately some of the new varieties which we had been recommending as better than the then standard POJ 36 and POJ 213, etc. canes, were practically immune to the disease, and as these new varieties had been propagated to a considerable extent, there was enough seed cane available to replant immediately most of the fields of the affected canes. For the rest, some varieties we classified as "not immune but highly resistant" were employed to fill the gap until the next replanting when more seed cane of the immune varieties would be available.

Now that the smut has got a foothold in this hemisphere, and is gradually spreading, we believe that the countries which it has not reached as yet should take special precautions to prevent this happening. But at the same time we think that they should "play safe" and try to avoid propagating and cultivating varieties which are known to be susceptible to the disease, and plant as far as possible only the practically immune varieties. In the first part of this article I have given the classification in this respect of a large number of canes, and the requisite data about other varieties, if not available, could be obtained by having them tested out in some country where the smut is prevalent.

I may say that the discovery of more immune varieties should not be difficult, for according to our experience they are relatively numerous, as is shown by the fact that of the 782 varieties we studied, 438 turned out to be "practically immune", 101 "highly resistant", and 243 "definitely susceptible". Of the fifteen Coimbatore canes we have here, six are "practically immune", five "resistant", and four "susceptible", while of the twenty-one "Canal Point" varieties we have studied, twelve are "practically immune", two "resistant" and seven "susceptible". It is interesting to note that among these latter there figures the C.P. 44/101, one of the canes most cultivated in Louisiana—which as we have seen we classify as "rather severely attacked".

(It must be pointed out that to be able to classify a variety of cane with respect to its susceptibility or resistance to the smut, it should be cultivated in a well infected field until at least the second year stubble, as results obtained from plant cane and first stubble are likely to be unreliable.)

What is really difficult, on the other hand, is to find varieties which as well as being practically immune to smut, possess also all the other qualities which they need to have for them to be entirely desirable for commercial planting, and to be as good or better than the canes they are destined to replace. Thus while the immune and resistant canes now cultivated in Tucumán have always given satisfactory results, many of the farmers still deplore their having had to give up the old varieties, remembering the high degree of frost resistance of the POJ 36, the early maturing of the POJ 213 and Tuc. 472, and the hardiness and great productivity of the Tuc. 1376.

Although we found the solution to the smut problem by planting immune varieties, we have dedicated much time to studying how to control the disease and get good yields without abandoning the otherwise desirable, susceptible varieties.

As we have noted on a previous page, this presents no problem with plant cane, as this is attacked to only a slight degree, which is insufficient to affect the yields of cane and sugar per hectare, and we have found that if only the upper third of the stalks is planted, the plant cane is usually altogether free from attack. We have also found that plant cane practically free from smut can be obtained even if the whole stalks are planted, if these are previously submerged in cold water for six hours, then in water at 52°C for twenty minutes, and then again in cold water for ten minutes. This treatment seems to kill out any infection there may be in the canes.

But while in these ways we can obtain plant cane of even the most susceptible varieties, practically free from smut, we have not been able to devise any practical method of preventing the attack in stubble cane, as the spores of the disease are present in the soil in large numbers, and we know of no feasible way of preventing the buds in the soil from becoming infected by them. However, we have observed that the intensity of the attack in the first year stubble is generally not so great as in the succeeding years, so that at least moderate yields of cane and sugar can usually be obtained in that year also, in spite of the disease. On the other hand, although as we have seen, from the results given in Tables II and III, in Tucumán even if the cane is cultivated for several more stubble years, the yields obtained are often much higher than might be expected, we believe that it should not be attempted to cultivate on a large scale very susceptible canes after the first stubble year, unless local experience with a given variety would appear to justify this procedure—as is the case, in Tucumán, with the Tuc. 1376.

In our efforts to control the smut without changing the susceptible varieties cultivated, we did a great deal of work in trying to discover methods of re-

ducing the incidence of the disease, such as by different ways of cultivating, increasing the fertility of the soil, the application of diverse substances to the soil, various treatments of the stubbles, etc., but the results we obtained were all negative. We studied also the possibility of conferring resistance or immunity to the susceptible varieties, by treating them in various ways, although we recognized the difficulties of this task, because, as G. L. FAWCETT discovered[5], resistance to the infection is not due to the chemical composition of the cane, but rather to the physical characteristics of the structure of the buds, upon which depends the possibility of the fungus penetrating the canes. In these studies we arrived at the conclusion that the most promising method would be to try to obtain resistant strains of the susceptible varieties, by the same procedure as is used for the discovery of "mutations". To this end the stubble cane growing in a large plantation would be thoroughly and carefully studied, in an endeavour to find stubbles of which the canes appeared to be resistant or immune. These stalks would be planted in a special plot, and cultivated until they were of second stubble, when the same procedure of selection and planting would be again carried out, repeating the operation until definitely resistant strains would be obtained. I have not been able to try out properly this method, but in years past we did obtain through it some interesting mutations of the POJ 36, POJ 213, Tuc. 385, Kassoer, and some other varieties, which were definitely richer in sugar than the usual cane of the respective variety.

But perhaps a more promising method of diminishing the incidence of the smut in the susceptible varieties would be to endeavour to reduce to a minimum the number of spores in the soil. For instance, taking advantage of the fact that these spores, in lands in which cane is not grown, die off within a few months, a system of rotation could be employed by which large extensions of cane fields, after the old stubbles were thoroughly ploughed out, would be sown to annual leguminous plants like cowpeas, soybeans, etc., for one year, or better two successive years, or else to leguminous perennials like alfalfa, for two years, after which the cane planted would be previously rendered free from smut by applying the hot water treatment described on a previous page. Of course these fields would again become infected in the course of time, by windborne spores from neighbouring fields, but we consider that this would be relatively slow, so that up to the third or fourth year stubble the damage suffered by the cane from the smut would only be slight.

On large estates which are separated from other cane plantations by considerable distances, it should be possible to extirpate the smut entirely, by killing off the spores in the way suggested in each field of cane before it is replanted, and then planting only immune varieties, so that finally the whole estate would be under these canes, and quite free from smut—though a permanent inspection should be maintained to detect any sporadic appearance of the disease, taking out and destroying the sick stalks in such a way as to avoid the dissemination of the spores. (This can be done by an experienced observer well before the black spore-bearing appendages are formed, as the infected shoots are taller and thinner than the healthy ones, and grow very erect, with short, narrow leaves.) After some two or three years, the susceptible varieties could again be planted, taking care to eliminate the smut entirely from the seed cane by the hot water treatment, and this cane could be kept free from the disease by the procedure mentioned, of careful inspection and rogueing.

Finally we consider that it should be possible to destroy the spores in the soil, by means of biological control, based on the action of natural enemies of the smut fungus. We have not found in the literature any references to insects or micro-organisms existent in the soil which destroy the spores, but think that such agencies may well be at least one of the causes of the great variation which as we have seen exists in the incidence of the disease in many countries, from one year to another, and also in the same year from zone to zone, and even from one field to another —and possibly too, the chief cause of the total disappearance of the disease which has been observed in certain cases. We have not been able to undertake a thorough search for such parasites. but consider that such a study would probably give very interesting and profitable results.

## AGRICULTURAL ABSTRACTS

**The influence of time of harvest and age of sixteen sugarcane varieties on their sucrose content.** G. SAMUELS *et al. J. Agric.* (Univ. Puerto Rico), 1960, **44**, 1–10.—A record is given of the maximum sucrose % cane of 16 varieties, with age, drawn from samples taken every 15 days from 6–23 months. Marked varietal differences were found in the age at which a peak was reached; a summarized figure, therefore, is of little value. Two peaks occur, one approximately at 10 months and the second at 21 months.

* * *

**Influence of height of cane and leaf stage at time of sampling on leaf-nutrient content of sugarcane.** G. SAMUELS *et al. J. Agric.* (Univ. Puerto Rico), 1960, **44**, 11–15.—At tiller heights of 1 ft – 3 ft no influence was found in the case of leaf N and K; a slight increase with height was shown in the case of P. Number of leaves (sampling time 7–13 weeks) showed a difference only in the case of P at 9 weeks, the difference in the two varieties involved being reversed.

* * *

**An enemy of the sugar cane.** W. H. LONG *et al. La Ind. Azuc.*, 1960, **65**, 15.—A general discussion is given of the various methods of control of the borer *Diatraea saccharalis*, including control by chemical and biological methods, cultural practices and cultivation of resistant varieties.

[5] *Rev. Ind. y Agric. de Tucumán*, 1946, **36**, 165.

# THE BACTERIAL MOTTLE PATHOGEN OF QUEENSLAND SUGAR CANE

By W. J. DOWSON, Botany School, Cambridge,
and A. C. HAYWARD, Commonwealth Mycological Institute, Kew

STEINDL[1] has published a short account of a new bacterial disease of sugar cane in Queensland, Australia. The symptoms consisted of chlorotic striping of the leaves which were entirely invaded as were also the sheaths and stems causing severe stunting, wilting and death. From the brown necrotic areas of the stems a bacterium was isolated which reproduced the disease following inoculation of the spindle by injection.

The Bureau of Sugar Experiment Stations, Brisbane, Queensland, forwarded cultures of the isolated and reisolated bacterium to Cambridge and the Commonwealth Mycological Institute, Kew, for confirmation of their preliminary identification of an Erminia-like pathogen.

At Cambridge the characters of the organism were found to be very like those of *Pectobacterium carotovorum* var. *atrosepticum* under which name it was referred to in the Bureau's 58th Annual Report for 1958.

About the same time the Bureau[2] informed us that the disease "had been found occurring naturally in the following grasses: *Pennisetum purpureum*, *Panicum maximum* and *Brachiaria mutica* and that the organism had been successfully inoculated into *Sorghum sudanense* and maize in which it produced a mottling of the leaves and that some plants developed a rot".

The reactions of sugar cane and maize were confirmed at Cambridge. The pathogen has most of the biochemical characters of *Pectobacterium carotovorum* (Jones) Dowson but as it will infect various grasses we consider it to be a variety for which the name *Pectobacterium carotovorum* var. *graminarum* is proposed.

The full description of the organism is as follows: *Pectobacterium carotovorum* var. *graminarum* var. nov.

Individual cells measure 0·4–0·6$\mu \times$1·5–3·0$\mu$, have 4–6 peritrichous flagella (few cells with more or less flagella) when stained by Bailey's method. Wieringa's pectate gel and gelatin are liquefied. Nitrite is formed from nitrate in a synthetic and in a peptone medium containing potassium nitrate. Acid and gas are formed in 24 hr from glucose, sucrose, fructose, galactose, arabinose, mannitol and salicin, from raffinose and lactose after 3–7 days incubation and acid alone from maltose after about 3 weeks incubation. The technique used was a modification of that described by HUGH and LEIFSON[3]. Aesculin is hydrolysed but not potato starch. No melanin pigment is formed on tyrosine agar. Hydrogen sulphide is produced in a peptone liquid medium supplemented with cysteine hydrochloride. Indole is produced. Citrate and malonate are utilized in KOSER's and LEIFSON's medium respectively. The V.-P. reaction is positive, M.R. negative. Tests for lipase (SIERRA[4]) and urease (CHRISTENSEN[5]) were negative. The optimum temperature for growth is about 30°C but the organism will grow at 40°C.

## AGRICULTURAL ABSTRACTS

**Biological control of the cane borer.** L. C. SCARAMUZZA. *La Ind. Azuc.*, 1960, **65**, 52.—The failure to secure full control of the borer *D. saccharalis* by *Paratheresia* in certain valleys is due to the abundance of hyper-parasites of the latter, and the problem of securing a higher degree of control in these cases through the introduction of other parasites is discussed.

* * *

**Progress in the fight against ratoon-stunting disease in Mauritius.** R. ANTOINE. *Mauritius Sugar Industry Bull.*, 1959, (11).—The bulletin is a reprint of the article published in *Rev. Agric Sucr.* (Mauritius), 1959, **38**, 214–221[6].

* * *

**Fertilizing sugarcane with rock phosphate.** ANON. *Victorias Milling Co. Expt. Sta. Bull.* (Philippines), 1960, **7**, 2.—This brief editorial notes the cultural practices which should be adopted if the full value is to be obtained from its use as a cheap, but acid-soluble form of phosphatic fertilizer.

* * *

**Splitting in sugarcane varieties.** M. M. SINGH and H. SINGH. *Indian J. Sugarcane Res. Develop.* 1959: **3**, 202–206; through *Plant Breeding Abstracts*, 1960, **30**, 1786.—An investigation at the Sugarcane Research Station, Jullundur, Punjab, showed cane splitting to be mainly a varietal character. Of the six varieties studies, Co. L9 and Co. L29 were almost free from splitting.

[1] *I.S.J.*, 1957, **59**, 174–5.
[2] *Bureau of Sugar Experiment Stations*, 58*th Annual Repor* 1958, 89–90.
[3] *J. Bact.*, 1953, **66**, 24.
[4] *Antonie van Leeuwenhoek J. Microbiol. and Serol.*, 1957, **23**, 15.
[5] *J. Bact.*, 1946, **52**, 461.
[6] *I.S.J.*, 1960, **62**, 182.

**Report on some experiments on the germination of true sugar cane seed.** S. LEE. *Taiwan Sugar*, 1959, **6**, (10), 23–32.—In addition to measurements in growth of the seed during maturation, data are given relative to germination. Thus seed 15 days from pollination shows poor germination; optimum germination is at 30–35 days. Notes are given of the effect of storage on germination.

* * *

**A review of sugar cane research in Florida, 1939-59.** T. BREGGER *et al. Sugar J.* (La.), 1960, **22**, (10), 17–23.—The review covers all branches of investigation from that of the soils of the Everglades and fertilizers to phytopathology and entomology.

* * *

**Soil conservation on steep slopes and hillsides.** T. D. ARCHIBALD. *S. African Sugar J.*, 1960, **44**, 209–211, 215.—In their "Rape of the Earth" JACKS and WHYTE expressed the view that the problem of soil erosion was more serious in South Africa than in any other country. Here is given the experience of one cane grower who compares the common cultural practice with a system of contours now followed by him for 6 years. The period is too short to give figures of statistical validity, but the last crops have ranged from 39–42·5 tons with a previous normal of 25–30 tons. The whole system is briefly described and includes the incorporation in the soil, in place of burning, of as much trash as possible.

* * *

**Double torpedo kills rats in cane fields.** ANON. *Sugar Research and Management Newsletter* (American Factors Associates Ltd., Hawaii), 1960, **2**, (1), 2.—The rodent habit of sampling bait before eating, has led to the development at Lihue, Hawaii, of a wax paper torpedo composed of an inner poisoned bait separated from an outer un-poisoned bait. The technique is the subject of a U.S. patent application.

* * *

**The irrigation of sugar cane in Taiwan.** WAN-CHUN HSU. *Taiwan Sugar*, 1960, **7**, (1), 14–19.—The standard methods are almost entirely of surface application and the main discussions concern water requirement and water sources and quality. Emphasis is laid on the desirability of switching over to sprinklers.

* * *

**6,902,729 rat-tails collected in 115 days.** T. C. FOK. *Taiwan Sugar*, 1960, **7**, (1), 20, 21.—This large bag resulted from a combined island campaign with "Warfarin" as the principal bait.

**Experiments on the growth of sugar cane cuttings as influenced by depth of planting.** H. CHANG and M. C. LIU. *Taiwan Sugar*, 1960, **7**, (3), 19–25.—The experiments described included comparisons of 2- and 3-node setts planted at 2 cm and 8 cm depth. Other factors considered are the slope at which the sett is placed (horizontal or 15°) and position of terminal bud (above, beneath or lateral).

* * *

**Differentiation of the flower primordia of sugar cane.** PAIR-YENN JUANG. *Taiwan Sugar*, 1960, **7**, (4), 13–16.—The main conclusion, drawn from a study of numerous varieties, is that there is a defined season at which flowering takes place irrespective of time of planting provided this is over five months. Marked differences are indicated in the flowering habits in 4 localities but, as temperatures in tabular form alone are given for these, no definite conclusions can be drawn.

* * *

**Spring paddy sugar cane in Taiwan.** H. CHANG and R. C. LIN. *Taiwan Sugar*, 1960, **7**, (4), 17–21.—This review of the experiments carried out since the 1953–54 season covers varietal responses, time of planting (optimum early April or half a month before rice harvest) and spacing (20,000 to 30,000 seed pieces per acre). Interplanting the cane with melon reduces cane yield by 3·4–5·9% but yields a net profit of 5·87%.

* * *

**Concerning nitrogenous nutrition and the utilization of urea in cane cultivation.** D. H. PARISH and S. M. FEILLAFÉ. *Rev. Agric. Sucr.* (Mauritius), 1960, **39**, 6–8.—In an experiment covering sulphate of ammonia and urea at 15, 30 and 45 kg N per arpent, the tonnage of cane per arpent and the foliar diagnostic and vegetative indices all increased in the case of sulphate of ammonia with increased N, but no increase was obtained above the 30 kg N/arpent level with urea. The various possible reasons for this inferiority of urea are outlined.

* * *

**Studies on the nematode soil fauna of sugar cane fields in Mauritius.** J. R. WILLIAMS. *Occ. Paper Mauritius Sugar Ind. Res. Inst.*, 1960, (4), 30 pp.—This is the fourth of a series[1] by the same author and follows the previous lines of taxonomical description of the various species. The group here covered is the *Tylenchoidea*.

[1] *I.S.J.*, 1959, **61**, 294.

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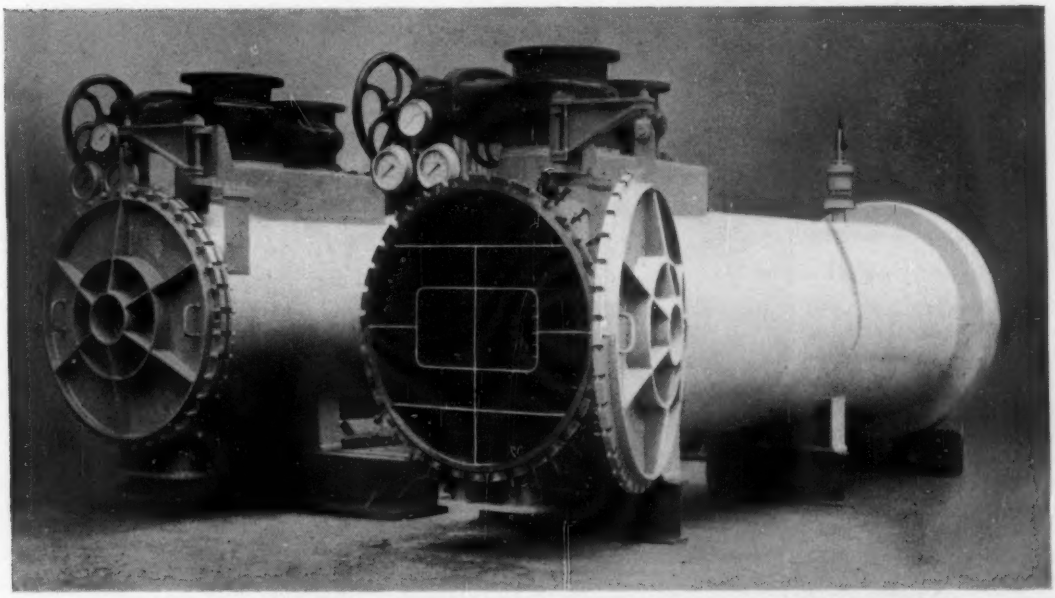

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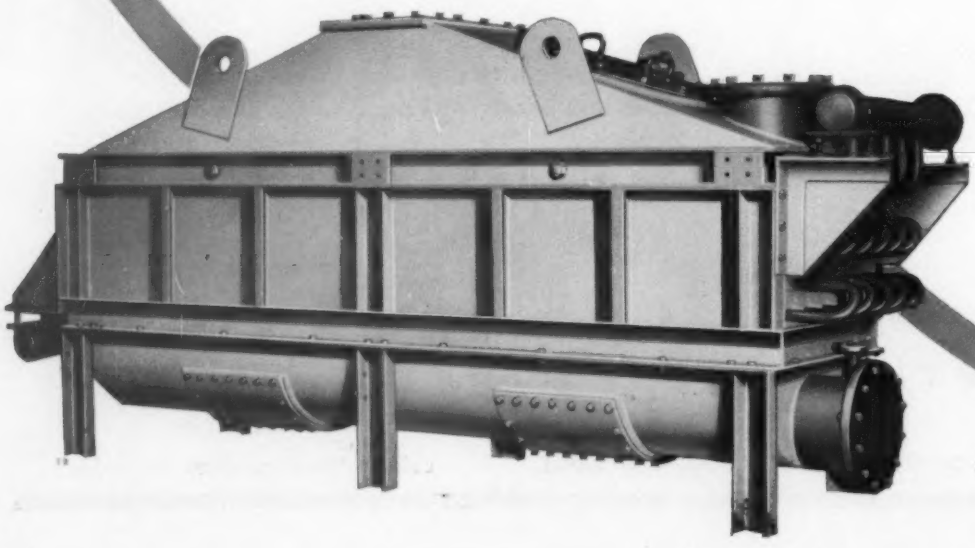

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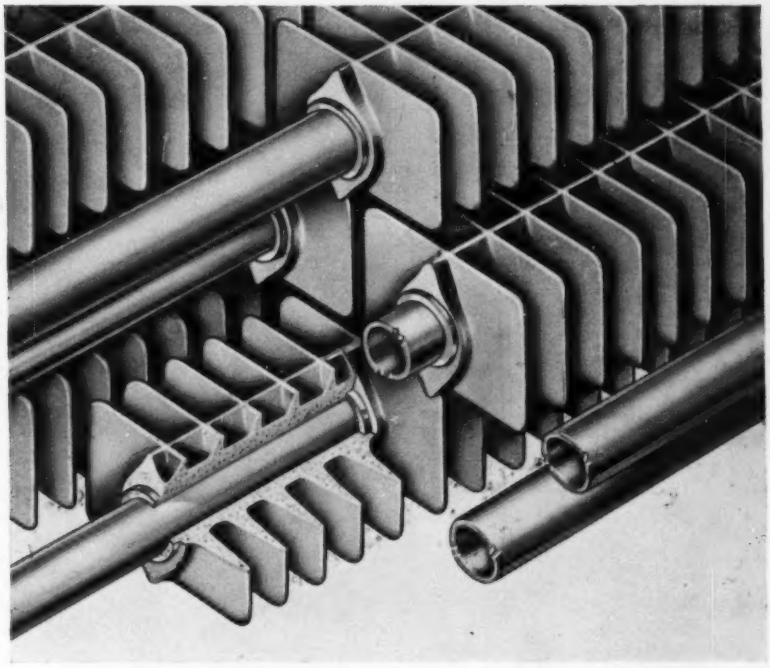

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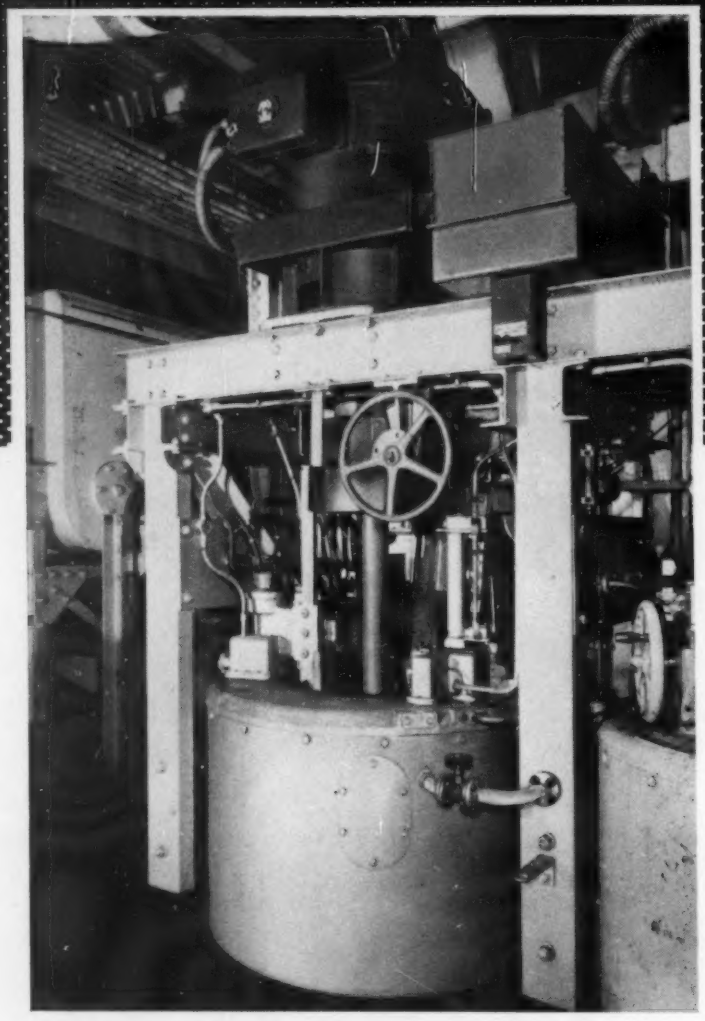

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# BIOLOGICAL TREATMENT OF SUGAR BEET FACTORY WASTE WATERS

By A. CARRUTHERS, P. J. GALLACHER and J. F. T. OLDFIELD
(Research Laboratories, British Sugar Corporation Ltd.)

*Abridged from a paper presented to the 13th Technical Conference of the British Sugar Corporation Ltd.*, 1960

LARGE quantities of water, of the order of 50 million gallons per day, are used at sugar beet factories in transporting the beet from the reception flumes and in rendering beet free from soil. The soil carried by the water is allowed to settle out in lagoons and as the clear overflow has a B.O.D. content of between 100 and 200 p.p.m. it becomes increasingly difficult owing to restrictions imposed by River Board authorities to discharge this water to rivers. At factories of the British Sugar Corporation arrangements have been made to re-cycle the settling pond waters and as a consequence the degree of pollution may reach quite high levels before the end of a campaign. This paper reports on the performance of biological filters in treating the polluted water and briefly describes alternative methods of treatment.

Analysis by gas phase chromatography showed that in highly polluted water the concentration of volatile acids was approximately proportional to the B.O.D. More than 90% of the volatile acids were accounted for as acetic and propionic acids; formic and butyric acids were present in minimum amounts. The measurement of volatile acid content can be carried out rapidly by distillation and titration and the result, expressed as p.p.m. acetic acid, can afford a useful supplement to the 5-day B.O.D. measurement and should be particularly useful for day-to-day guidance in the operation of the purification treatment.

The Biological Filter, often referred to as a percolating or trickling filter, was first developed in England in the 19th century for the purification of sewage and it is still the most widely used method for treating domestic wastes. Domestic sewage is fed into a sludge tank and the ensuing liquid is applied to a bed of filter material usually composed of stones, clinker or similar hard wearing material, which has been graded to a fairly uniform size, usually about $1\frac{1}{2}$–$2\frac{1}{2}$ inches diameter. The waste may be applied through fixed nozzles on the surface of the filter bed or, as is now more common, through holes bored in rotating arms which spread the liquid evenly over the surface of the stones. The waste then trickles down through the filter in a thin film, which ensures close contact with the oxygen in the air spaces between the stones, to be collected in drains at the bottom of the filter.

The stones gradually develop over their surfaces a zoogleal slime, composed of various fungal organisms and bacteria. The time taken for the slime to develop is variable depending upon the temperature within tne filter; for domestic sewage the time required is usually about 2–4 weeks. In starting up a new filter for the treatment of industrial waste waters it is, therefore, often essential if the filter is to come into service without too long a delay, to use a mixture of sewage and the waste for the first few weeks until good growth is established.

It is necessary in order to get the best results from a trickling filter to have adequate settling arrangements for treating the waste both before and after it passes through the filter bed. The primary settlement removes suspended soils, which may cause blockages in the filter, and the secondary settling is needed to remove the flocculant particles which are flushed from the filter itself.

In starting up a biological filter for the treatment of our industrial waste water, experience has shown that the filter can be rendered effective in a shorter time if domestic sewage can be applied together with the trade effluent. In part, this speeding up process may be due to the presence of micro-organisms in the domestic sewage. Where it is not possible to apply domestic sewage advantages may also be gained from applying a quantity of humus collected from the humus tank of a sewage works. Since persistently toxic chemicals are not used in a beet sugar factory one might anticipate that a biological filter, once its activity had been established, would have no difficulty in effecting satisfactory purification of settling pond water and that this is so has been demonstrated at two of our factories.

It is generally considered that a biological filter should be able to deal with a daily loading of about 0·2 lb B.O.D. per cubic yard of filter. It is evident from the data shown in Table 1 that the filter at Bardney factory has dealt with a load in excess of this level over quite considerable periods and particularly in those months when the temperature of the

**Table I**

**Performance of Bardney trickling filter treating transport water wastes**

| *Month* | *Temperature of waste applied to the filter* (°C) | *Gallons pond water per cu. yard filter* | *Gallons per cu. yard waste applied to the filter (pond and river water)* | *lb B.O.D. per cu. yard filter* | *B.O.D. reduction* (%) |
|---|---|---|---|---|---|
| January ..... | 3 | 78 | 167 | 0·26 | 68 |
| February .... | 4 | 20 | 72 | 0·35 | 89 |
| March ..... | 5 | 20 | 100 | 0·15 | 83 |
| April ..... | 9 | 41 | 156 | 0·42 | 97 |
| May ..... | 10 | 60 | 175 | 0·51 | 96 |
| June ..... | 15 | 112 | 224 | 0·77 | 95 |
| July ..... | 19 | 138 | 230 | 0·76 | 96 |
| August ..... | 21 | 210 | 260 | 0·61 | 93 |
| September .... | 17 | 280 | 280 | 0·23 | 76 |
| October ..... | 8 | 321 | 321 | 0·07 | 55 |
| November .... | 6 | 256 | 275 | 0·28 | 84 |
| December .... | 5 | 129 | 221 | 0·33 | 84 |

waste water was above 10°C. The pH of the undiluted waste (transport) water was measured at regular intervals and always fell within the range of 7·6–8·5. The pH of the water coming from the filter fell within the range of 7·8 to 8·3.

The effluent from the filter conformed to the strict limits laid down by the Area River Board and during the period January to December 1955 the total volume of settled pond water applied to the filter was just under 32,000,000 gallons.

The data in Table 1 illustrate that the volumes of pond water applied to the filter increased considerably between April and December and part of the reason why this could be done is evident from the data in Table 2. It is apparent that the water in the pond, from which the filter at Bardney is supplied, underwent a considerable degree of self purification and this, of course, explains why it was possible to use in August just under 22 gallons per minute of river water for dilution of the pond water before application to the filters whereas in May the dilution water was used at a rate of 50 gallons per minute. In September and October no dilution water was required. These data on the performance of the filter at Bardney reflect the careful attention that has been given to the operations.

**Table 2.**

**Self purification of transport water wastes in Bardney pond.**

| *Month* | *B.O.D. (p.p.m.)* | *Fall in B.O.D.* (%) |
|---|---|---|
| March .... | 1239 | — |
| April ..... | 1169 | 6 |
| May ..... | 847 | 27 |
| June ..... | 719 | 15 |
| July ..... | 546 | 24 |
| August ..... | 284 | 48 |
| September .. | 106 | 63 |
| October .... | 38 | 64 |

A high standard of performance has also been achieved at Ely factory and here it was possible to treat in about 5 months, on two trickling filters, 28,000,000 gallons of settling pond water produced during the 1958-59 campaign in processing about 420,000 tons of beet.

It would appear, from the achievements at Bardney and Ely, that provided adequate attention is given to its operation, the percolating filter may, under certain circumstances, be able to cope with the problem of purifying settling pond water. It has been suggested to us by Mr. WHEATLAND of the Water Pollution Research Laboratory that the factor which may influence the efficacy of a biological filter is the phosphate content of the water being treated. Experience, it is said, indicates that for every 100 p.p.m. of B.O.D. the water should contain phosphate equivalent to not less than 1 p.p.m. of P. In this connexion it is interesting to note that the waters being applied at Bardney and Ely contained about 1 p.p.m. of P. Further experimental work will have to be done to establish whether the suggested ratio of B.O.D. : P is critical in the treatment of settling pond waste waters. Factories which put transport water through a settling tank have frequently found that lime additions help to clarify the water and if this treatment reduces the phosphate content of the water to a sufficiently low level it is possible, in these circumstances, that to achieve maximum performance from the biological filter it may be desirable to add phosphate.

### *Alternating double filtration*

The biological filters at Bardney and Ely are being operated in a straightforward manner which is usually referred to as "standard." Bardney has only one filter and it must, therefore, be operated as a "standard" filter. Ely, however, has two filters and, although they are both operated as "standard" filters, they could, in fact, be operated in series since the pumping system necessary for the purpose is installed. The Water Pollution Laboratory, between 1935 and 1938[1], developed this procedure in the first place for the treatment of waste water from a dairy and later applied it with success for large-scale treatment of sewage[2].

[1] *D.S.I.R. Water Pollution Research Tech. Paper*, 1941, (8).
[2] DAVISS: *Sewage & Ind. Wastes*, 1951, **23**, 437.

Pumps and connexions have to be arranged so that each of two filters can be either the primary or the secondary stage, settled effluent from the primary filter being applied to the secondary stage. The sequence of operations is reversed at regular intervals, the timing of which is governed by the tendency to ponding shown by the primary filter. The usual practise is to change over once per day. With alternating double filtration, the Water Pollution Laboratory showed[3] it was possible to apply waste water at the rate of 240 gallons/cu.yard/day whereas with a single standard filter the highest rate never exceeded 80 gallons. The B.O.D. of the waste being treated varied between 105 and 180 p.p.m. and the B.O.D. of the effluent water was less than 20 p.p.m.

*High rate filters*

Another procedure for the operation of biological filters, which usually employs recirculation, was developed in the U.S.A. and is known as "high rate" treatment. The loads applied to filters operated in this manner are of the order of 2 lb B.O.D./cu.yard of filter volume and the rates of application are as high as 10–30 million gallons per acre of surface area per day. The hydraulic loading is, in fact, particularly important and it has been stated[4] that the surface load should normally exceed 10 m.g.a.d. and never be less than 7 m.g.a.d. Without the flushing action of the high hydraulic rates there is a danger that the filters may clog since zoogleal slime formation can be heavy as a result of the high B.O.D. loading. Continuous discharge of humus occurs with these filters and it is most important that adequate settling tank arrangements should be provided.

In practice, "high rate" filters have been used under conditions where the limits of B.O.D. for the final effluent are less severe than they are in this country. It was of interest to conduct experiments to find out what might be achieved on a "high rate" filter when it was operated on the heavily polluted settling pond water produced at one of our factories with the return water system where all the campaign usage is stored and settled water recycled. An experimental unit consisting of two 2 ft glazed earthenware drain pipes, of 6 in diameter, was set up in our laboratory at Bramcote. The 4 ft depth of pipe was filled with stones, each about 1–1½ inches diameter. That the filter operated efficiently within a few days of starting up was undoubtedly due to the fact that a portion of the stones which were put into the filter were obtained from the local sewage works.

The results which were achieved on the experimental "high rate" filter are shown in Table 3. The B.O.D. reductions are not as impressive as might be expected and compare rather unfavourably with results reported in the literature[5] for an 8-ft filter, when operations were carried out on cannery wastes. On this experimental filter and at hydraulic rates of 20 m.g.a.d. B.O.D. reductions were obtained as follows: 60% on beet wastes, 70% on corn wastes and 70% on tomato wastes. Inadequate, as well as uncertain, pump performance almost certainly reduced the efficiency of the pond water treatment on our filter and it is fully expected that better results will be obtained when adequate equipment is installed.

**Table 3**

**High rate treatment of transport water waste on laboratory scale biological filter**

| *Date of Sampling* | *Waste water applied* (gal/cu.yard/day) | *Wastes applied to filter (including recirculation)* (Gal/cu.yard/day) | (lb B.O.D./cu. yard/day) | *B.O.D. reduction* (%) |
|---|---|---|---|---|
| 29.4.60 | 870 | 2470 | 4·2 | 34 |
| 4.5.60 | 760 | 2270 | 3·9 | 44 |
| 5.5.60 | 460 | 1820 | 2·7 | 42 |
| 6·5·60 | 780 | 2340 | 3·9 | 31 |

*Treatment of undiluted waste water*

In all of the above described methods for the treatment of polluted waters some degree of dilution either direct and/or by recirculation was practised. In Russia[6] extensive exploratory work has been carried out in which undiluted waste from a sugar factory was applied at low rates. A 3-stage biological filter system was used and apparently no troubles due to ponding were encountered. Waters having a B.O.D. of the order of 4000 – 5000 p.p.m. were used and overall reductions in B.O.D. of 75 – 85% were attained. The quality of the final effluent, however, was not up to the standard required by our River Board Authorities.

*Enclosed type of filter*

In an investigation carried out over 4 years it was shown that an enclosed filter could treat, per cu.yard of filter material, twice as much domestic sewage as could be dealt with by a "standard" filter. That better results were achieved on the enclosed filter is probably due to the existence of enhanced temperature and aeration conditions. That this system has not been more widely adopted may be explained by higher installation costs.

## Aeration and the Activated Sludge Process

The efficacy of a biological filter is dependent upon the development of a good growth of micro-organisms on the surface of the media and also on oxygen being available in amount adequate to enable the biochemical mechanisms to render the input liquor free from oxidisable compounds. That sewage could be converted in the absence of media into a liquor with a low B.O.D. content was first demonstrated by Arden & Lockett[8] who employed aeration in tanks. They observed that in aerating sewage a sludge was gradually formed over about two weeks and if part of the sludge was collected and introduced into fresh sewage the time of aeration required to

[3] Mills: *J. & Proc. Inst. Sew. Purif.*, 1945, (II), 35.
[4] Halvorson: *Water Works & Sewerage*, 1936, **83**, 307.
[5] Warrick *et al.*: *National Canners' Assoc. Bull.*, 1939, (28-L).
[6] Chekurda: *Trudy Tsentr. Nauch.-Issledov. Inst. Sakhar. Prom.*, 1958, **5**, 216; *I.S.J.*, 1959, **61**, 340.
[7] Hunter & Cockburn: *J. Inst. Sew. Purif.*, 1944, 12.
[8] *J. Soc. Chem. Ind. Lond.*, 1914, **33**, 523.

reduce the B.O.D. to low levels was not more than a few hours. The process of aeration and recirculation is now known as the Activated Sludge Process. To obtain good results from this process it is important that the method of aeration should not only guarantee the supply of the necessary amount of oxygen to ensure breakdown of oxidisable matter but is should also cause enough agitation to keep the sludge in suspension so that maximum contact is ensured between sludge and waste water. Only a portion of the sludge need be returned to the aeration tanks; it is usually sufficient if the amount returned will give a concentration of the order of 1000 to 3000 p.p.m.

Since the process was first described, many modifications have been introduced. One that appears to be very common is to provide an extra tank in which the returned sludge can be aerated before it is mixed with the waste water. Another modification, which has proved very efficaceous, is to introduce the waste water at different points along the aeration tank, rather than mixing it direct with the return sludge prior to entry into the aeration tank. A "high rate" modification has also been developed but although it shortens the aeration time the degree of purification attained is not as good as with the more standard treatment.

In applying the process to industrial wastes it has been found advantageous to feed in a small proportion of domestic sewage; sewage facilitates the formation of the active sludge. Activated sludge plants working on sewage, it is said, effect a higher degree of purification than is attained on percolating filters. The have the advantage that they operate almost as efficiently in winter as in summer and in general they occupy less area than do biological filters. The period of aeration required varies with the type and strength of waste being treated and, of course, with the design of plant. For sewage of normal strength, periods of aeration between 5 and 6 hours effect reductions in B.O.D. of 90 – 98%. With the high rate process, the aeration time may be no more than 2 to 3 hours and B.O.D. reductions of 75 – 80% are obtained.

*Experiments to simulate the activated sludge process*

To test the full possibilities of applying the Activated Sludge Process to settling pond water it would be necessary to fit up a unit complete with adequate aeration and with means of removing sludge as well as of returning a portion of the sludge. The preliminary experiments which are described below were carried out under much more primitive conditions.

Waste water from a highly polluted pond was diluted and to the solution was added a small amount of the slime that had formed on the small scale laboratory percolating filter. Air, under slight pressure, was blown into the diluted waste water through a tube fitted with a sintered glass distributor. The aeration was stopped after some arbitrary time and the sludge allowed to settle. The clear liquid was decanted off and examined for B.O.D. content. To the settled sludge a fresh quantity of diluted waste water was added and the sequence of aeration, settling and decantation was repeated. The results of these experiments are shown in Table 4.

**Table 4**

**Activated sludge treatment of transport water wastes on laboratory scale**

| | *Period of aeration* | *B.O.D.* | | |
|---|---|---|---|---|
| | *(hours)* | *Initial (p.p.m.)* | *Final (p.p.m.)* | *Reduction %* |
| 21.4.60 | 6 | 410 | 193 | 53 |
| 22.4.60 | 17 | 410 | 71 | 83 |
| 22.4.60 | 6 | 410 | 214 | 48 |
| 27.4.60 | 18 | 410 | 44 | 89 |
| 28.4.60 | 23 | 410 | 40 | 90 |
| 4.5.60 | 20 | 310 | 29 | 91 |
| 5.5.60 | 24 | 410 | 20 | 95 |
| 6.5.60 | 16 | 410 | 27 | 93 |

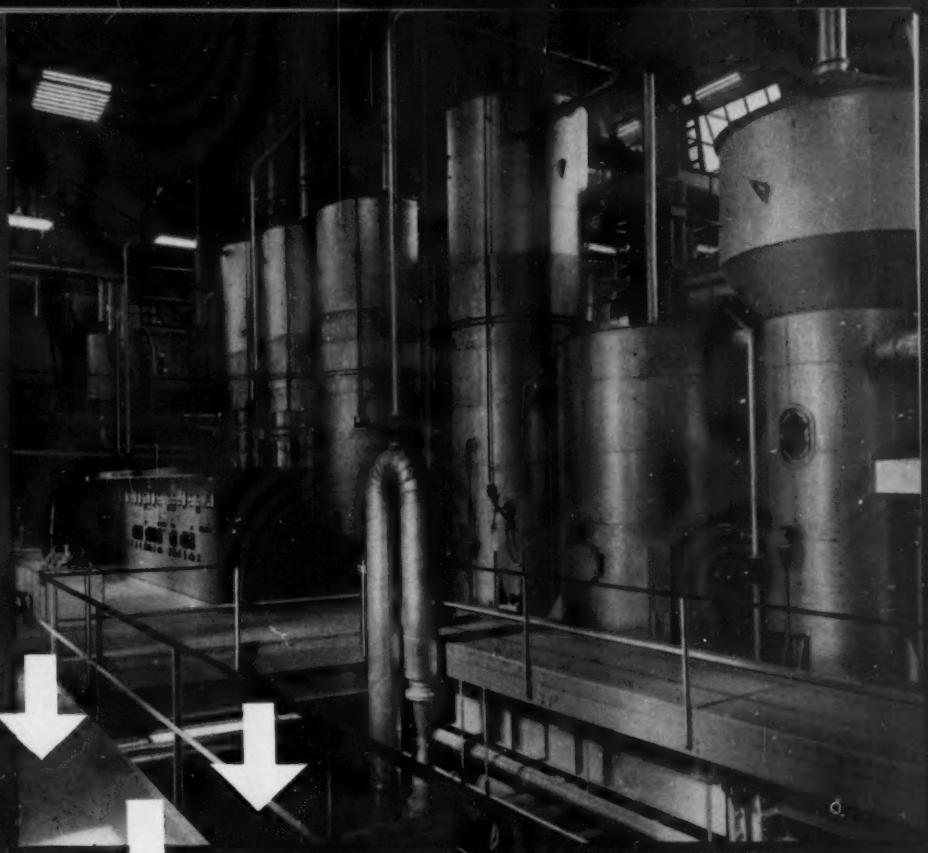
The B.O.D. measurements reported in the table were carried out on decanted liquors which contained appreciable amounts of fine particles of sludge. It is of interest to note that distinctly lower values for B.O.D. were obtained if the measurements were made on the liquors after removal of sludge by filtration. For the experiments carried out on 4.5.60 and 5.5.60 the B.O.D. values shown in Table 4 for the final liquors were 29 and 20 respecively. The corresponding B.O.D. values obtained on the liquors after filtration were 6 p.p.m. and 9 p.p.m. and adopting these latter values it is possible to calculate that B.O.D. reductions of 98% were obtained in both experimental runs. The actual periods of aeration that were used to effect these reductions were relatively long; there are good reasons for supposing that these times could be reduced considerably. Further studies are being carried out to explore fully the potentialities of the Activated Sludge Process as an alternative to the Biological Filter for the purification of settling pond water.

*Aeration in the absence of activated sludge*

In the above described experiments in which marked reductions in B.O.D. were obtained the aeration was carried out in the presence of a sludge which in the first place was obtained from a percolating filter. That aeration applied in the absence of sludge leads to quite different results is illustrated by the following experiments.

A quantity (1 litre) of undiluted pond water was introduced into a glass jar which was fitted with a glass tube through which air could be delivered. After a period of aeration a portion of the treated water was transferred to a fresh sample and the system of sub-inoculation and aeration was continued over a series of tests. The B.O.D. and volatile acids contents of the treated waters were measured and the results obtained are reported in Table 5.

It is apparent that aeration alone effected a reduction in B.O.D. and volatile acid content but even after prolonged periods of aeration, and particularly if carried out at temperatures below 10°C, the reductions were poor in comparison with those achieved



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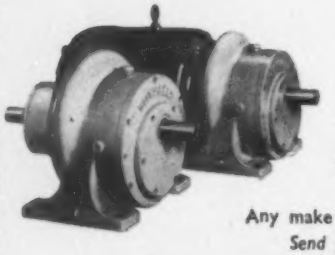

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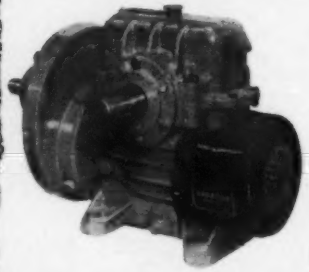

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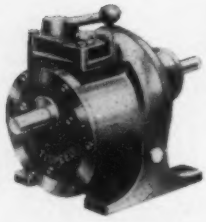

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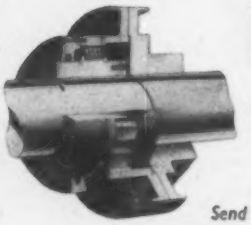

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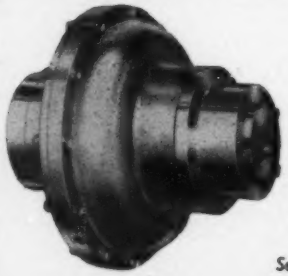

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WORLD-WIDE REPRESENTATION

**Table 5**

**Aeration of waste waters without sludge addition.**

| *Sub-culture* | *Days aerated* | *Volatile acids (p.p.m.)* | | |
|---|---|---|---|---|
| | | *Initial* | *Final* | *Reduction (%)* |
| 1 | 3 | 4700 | 2500 | 47 |
| 2 | 6 | 4700 | 400 | 91 |
| 3 | 11 | 4700 | 520 | 89 |
| 4 | 7 | 5700 | 1800 | 68 |
| 5 | 8 | 4500 | 2800 | 38 |

| *Sub-culture* | *Days aerated* | *B.O.D. (p.p.m.)* | | |
|---|---|---|---|---|
| | | *Initial* | *Final* | *Reduction (%)* |
| 1 | 3 | 6400 | 2700 | 58 |
| 2 | 6 | 7100 | 740 | 89 |
| 3 | 11 | 7100 | 630 | 91 |
| 4 | 7 | 10,400 | 3800 | 63 |
| 5 | 8 | 8600 | 3800 | 55 |

in the presence of Activated Sludge. It was observed that after 3 or 4 days of aeration the waters tended to become viscous, apparently owing to the growth of capsulated bacteria.

A further series of tests were carried out using controlled aeration and the results reported in Table 6 indicate that in terms of B.O.D reduction only slight advantages would be gained by aeration of settled pond water. If the water were aerated long enough to raise the viscosity the process might jeopardise subsequent treatment of the water, say, on a biological filter.

**Table 6**

**Controlled aeration of waste waters without sludge addition. Reduction in volatile acids and B.O.D.**

| | *Normal aeration 22 litres/hour* | | *Reduced aeration 4·5 litres/hour* | |
|---|---|---|---|---|
| *Days aerated* | *Volatile acids (p.p.m.)* | *B.O.D. (p.p.m.)* | *Volatile acids (p.p.m.)* | *B.O.D. (p.p.m.)* |
| 0 | 6300 | 9300 | 6300 | 9300 |
| 2 | — | 8300 | — | 8400 |
| 3 | 5300 | — | 5600 | — |
| 5 | 3700 | 7300 | 5900 | 7900 |
| 7 | — | 3700 | — | 7200 |

Experiments were also conducted to determine if additions of ammonium nitrate would prove beneficial during aeration. The results obtained, shown in Table 7, indicate that ammonium nitrate had but a slight effect on the rate of change of B.O.D. content.

**Table 7**

**Effect of ammonium nitrate on the rate of fall of B.O.D. and volatile acids in aerated transport water wastes**

| | Control | | 0·05% $NH_4NO_3$ | |
|---|---|---|---|---|
| *Days aerated* | *Volatile acids (p.p.m. acetic)* | *B.O.D. (p.p.m.)* | *Volatile acids (p.p.m. acetic)* | *B.O.D. (p.p.m.)* |
| 0 | 5800 | 7800 | 5800 | 7800 |
| 2 | 4900 | 7200 | 5600 | 7200 |
| 4 | 4000 | 6600 | 4600 | 5700 |
| 9 | 2500 | 2700 | 1500 | 2000 |

## Measures to control Sulphide Formation

Stagnant polluted water in a settling pond is generally dark coloured and often possesses a slight smell of sulphide. Manifestation of these properties indicates a deficiency of oxygen in the water, i.e. of the existence of conditions favourable to the activity of anaerobic bacteria. Soil is known to contain anaerobes which can reduce sulphate to sulphide and as beet and soil both contain sulphate it is obvious that until the oxygen demand of the water-mud system has been satisfied the conditions in a settling pond may present an opportunity for production of sulphide.

Since the smell of sulphide, even in minute traces, is objectionable it is obviously desirable at all times to prevent its release into the atmosphere. The coal gas industry has encountered this problem and after intensive investigation it was found that additions of the compound "Dichlorophen" to the water used to seal the gas holders were effective in suppressing the production of hydrogen sulphide formed by the sulphate-reducing bacterium *Desulphovibrio desulphuricans*. "Dichlorophen" (5,5′-dichloro-2,2′-dihydroxydiphenylmethane) is effective in relatively small doses.

Analysis of samples taken from the waste waters of a fresh water system and a return water system factory confirmed the presence of appreciable amounts of sulphate. Except on one accasion when a content of 2 p.p.m. was observed at one site the sulphide content of samples taken during the campaign never exceeded a level of 1 p.p.m. However, when the samples were stored in the laboratory they gradually blackened and after a period of 3–4 weeks the sulphide content was found to have increased to a level of 7 p.p.m.

### *Experiments using "Dichlorophen"*

Varying amounts of a solution of "Dichlorophen" in dilute caustic soda were added to 100-ml quantities of polluted water taken from the pond of the factory using the return water system. The solutions were incubated at 20°C and examined periodically for colour and sulphide. After 4 days the control, containing no "Dichlorophen" was distinctly dark and contained sulphide. In the presence of 10 p.p.m. of "Dichlorophen" colour and sulphide formation were suppressed for about 6 days but with 20 p.p.m. the solutions were still free from colour and sulphide after incubating for 7 weeks.

That prolonged aeration does not destroy anaerobes was demonstrated as follows: polluted water was aerated continuously for 11 days and after this time samples were treated with varying doses of "Dichlorophen" and incubated (without aeration) at 20°C. The control, to which no "Dichlorophen" was added, again developed colour and sulphide in 4 days, the sample containing 10 p.p.m. showed positive reactions in 6–8 days and the sample containing 20 p.p.m. showed negative reations even after 8 weeks. It appears from these results that aeration suppresses but does not destroy the sulphide-forming bacteria in the waste waters from the pond .

Having demonstrated the ability of "Dichlorophen" to suppress the activity of anaerobic micro-organisms it was clearly desirable that tests should be carried out to determine what effects, if any, this compound

would have on aerobic systems. In the first place a comparison was made of the changes in B.O.D. and volatile acid content during the aeration of a control sample of polluted water, to which no "Dichlorophen" was added, and of a sample containing 25 p.p.m. of "Dichlorophen."

**Table 8**

**The effect of "Dichlorophen" on the reduction of the B.O.D. and volatile acids in transport water wastes by aeration**

| | *No "Dichlorophen"* | | *25 p.p.m. "Dichlorophen"* | |
|---|---|---|---|---|
| *Days aerated* | *B.O.D. (p.p.m.)* | *Volatile acids (p.p.m. acetic)* | *B.O.D. (p.p.m.)* | *Volatile acids (p.p.m. acetic)* |
| 0 | 10,400 | 5700 | 10,400 | 5900 |
| 2 | — | 5400 | — | 5500 |
| 4 | 8,800 | 4200 | 8,500 | 3600 |
| 7 | 3,800 | 1800 | 3,900 | 1300 |

From the results shown in Table 8 it is apparent that 25 p.p.m. of "Dichlorophen" had no inhibitory action on the micro-organisms responsible for reducing B.O.D. and volatile acid content of waters.

The result of this experiment indicates that if "Dichlorophen" were added (in limited amounts, of course) to a pond water, as a measure for the prevention of possible formation of sulphide, no adverse effects would be expected on subsequent treatment of the water, either by a percolating filter or by the Activated Sludge process. Confirmation of this view is clearly desirable and will be sought by further experiments.

Concentrated solutions of the sodium salt of "Dichlorophen" are available commercially (one preparation is known as "Panacide") and accordingly a series of tests were carried out with these preparations. The results confirmed and amplified those which had been obtained with solutions made from the solid "Dichlorophen" and, in particular, they indicated that prolonged inhibition of sulphide formation could be obtained with 15 p.p.m. "Dichlorophen."

Although there appears to be no reason why "Dichlorophen" should not be used as a means of suppressing sulphide formation in stagnating settling ponds, nevertheless its use should be carefully controlled since the compound is apparently remarkably persistent.

# WHEN BREAKDOWN OCCURS

**By C. W. BRETT, M.Inst.W.**

**(Executive Director, Barimar Ltd., Scientific Welding Engineers.)**

SOME years ago the writer visited a large sugar factory, the manager of which was at pains to point out that, like farming, processing was governed by the season. During the months of intense activity when raw material is flowing into the factory, there must be absolute reliability, the only time for extensive maintenance and repair being at the off season.

In general practice this works out fairly well but notwithstanding the utmost care it is impossible to avoid an occasional unheralded breakdown, for sugar production is no gentle occupation, it is a tough business. Most of the trouble that arises can be put right without serious loss of time but there are cases of a different kind.

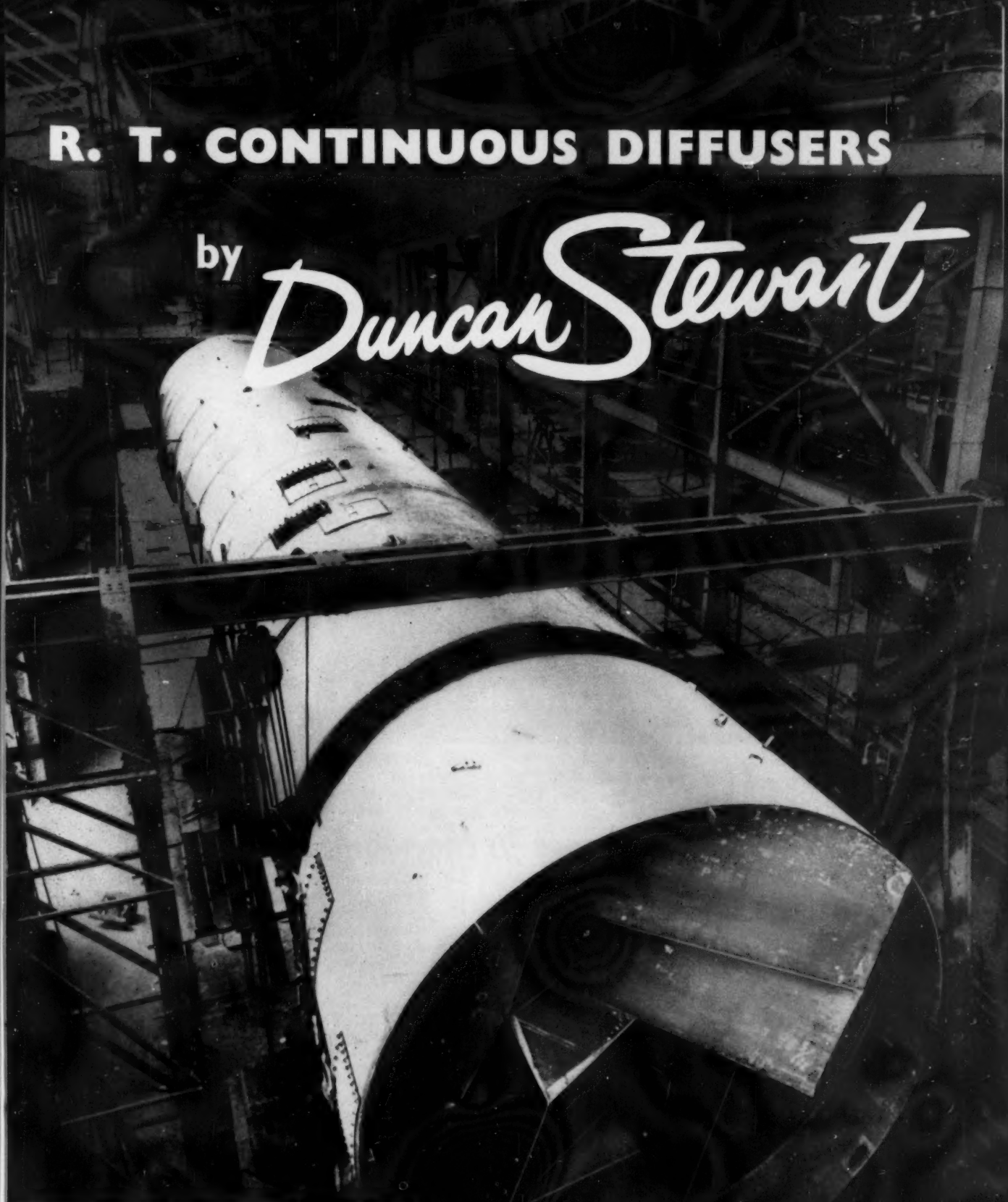
Coming within the category of major trouble was the totally unexpected breakage of a large elevator screw used for lifting beet from the delivery dump. There was no apparent reason why this component should fracture but it did, cutting output by nearly 50%. No replacement was immediately available; thus repair was the only possible solution. The work was entrusted to a firm of scientific welding engineers and completed in a remarkably short time by dint of night and day shifts. Subsequent service has proved the elevator to be stronger than it was originally.

Had the component been still larger it might have saved time to have carried out the work on the site. To this end operators, with portable self-contained equipment, are in a constant state of readiness to deal with emergencies that welding can cure. Whilst it is better to deal with repairs in the shops of the specialist engineers, largely on account of machine shop facilities being available to finish off work subsequent to welding, a surprising amount of "on site" jobs are undertaken upon boilers and other large items of equipment.

Apart from a repair of the type described, welding is invaluable for dealing with cases of excessive wear together with corrosion problems. Obviously there are instances in which fairly rapid wear must be accepted as an unavoidable condition of some particular duty but trouble of this kind can be discouraged by carefully choosing one or other of the large range of special weld metals now available. Certain of the hard abrasion resisting steels applied by experienced operators can double and even treble the life of a component handled in this way. Corrosion problems are dealt with by using stainless steel or possibly a non-ferrous alloy. In such ways parts normally subjected to trouble are made superior to a replacement costing far more than the modest price of welding.

# R. T. CONTINUOUS DIFFUSERS

by *Duncan Stewart*



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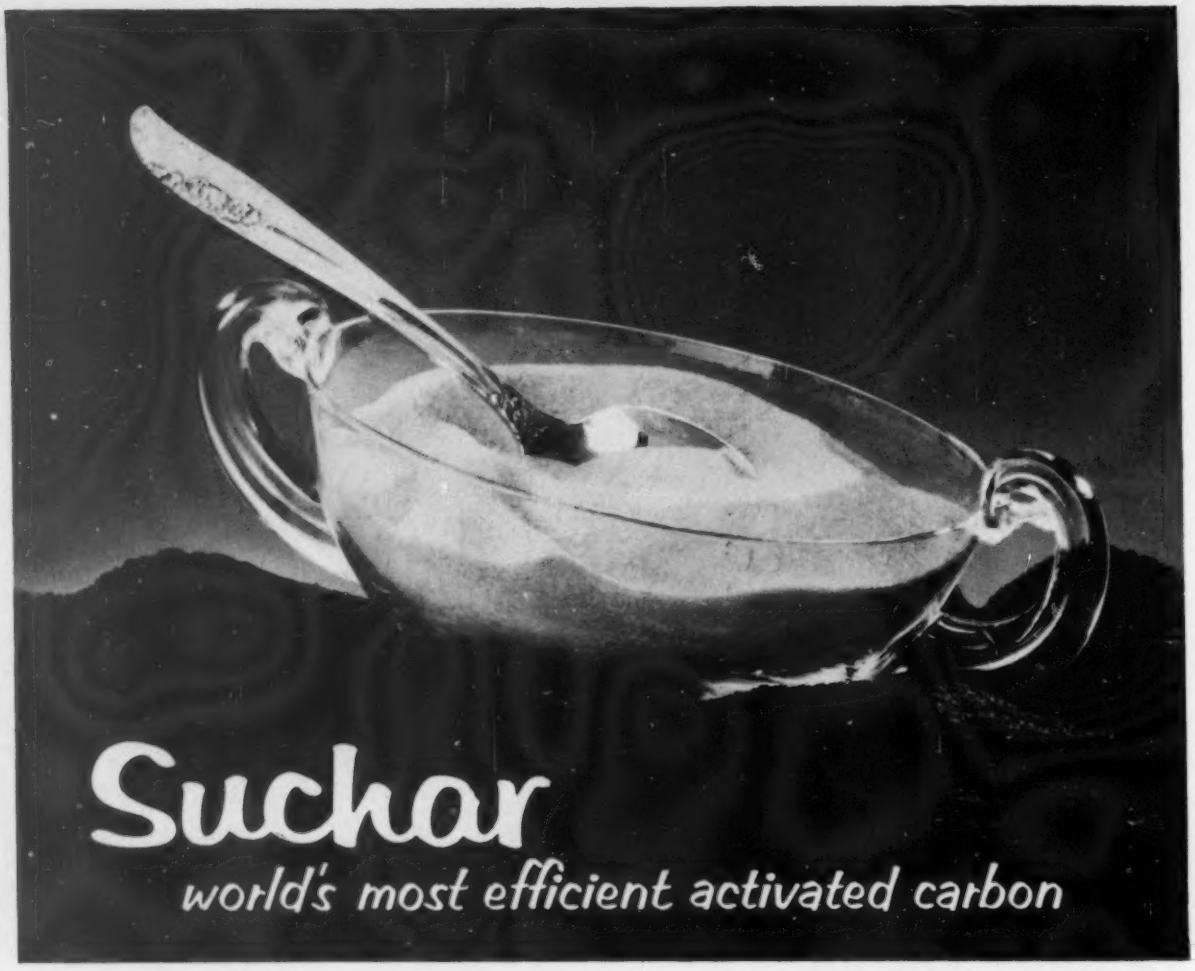


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It is necessary to balance the picture by pointing out that work of the highest precision is undertaken. Perhaps the best illustration of this is the substantial number of broken crankshafts that are reunited after fracture, usually through a web. When a smash of this kind arises it is a common happening for the shaft to be distorted as well as broken. Operators trained in modern welding techniques can impart any desired degree of strength but absolute truth of alignment is even more demanding upon their skill. Nevertheless, work of this type, in common with all other welding undertaken by specialist firms, is guaranteed on a money-back basis not only in regard to complete dependability but also in relation to accuracy. Crankshafts, for example, are guaranteed true in all respects to within a thousandth part of an inch but sometimes even closer tolerances are specified and accepted.

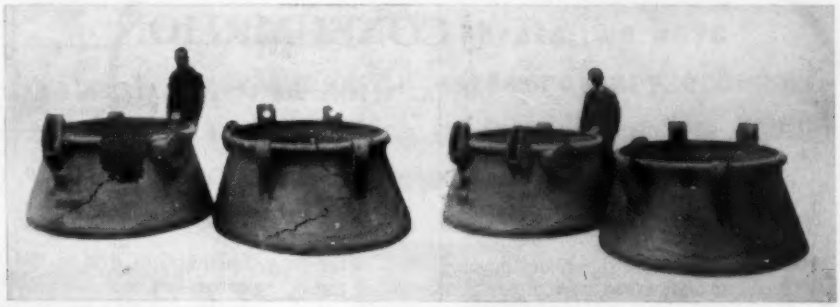


Fig. 1. Two badly fractured vessels in which the major damage was round a big lug that formed part of the hinge for the heavy covers; a strong repair was made by scientific welding and, as can be seen, there was hardly a sign on the repaired vessels. (A "Barimar" repair.)

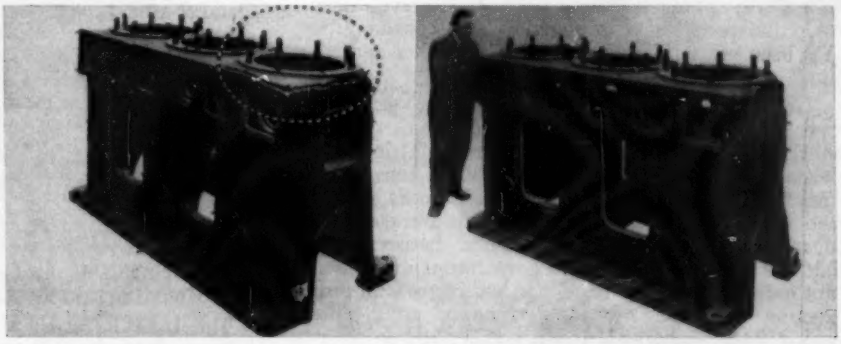


Fig. 2. The crank-chamber of a diesel engine was badly cracked where one of the heavy cylinders is bolted down; an economical, strong and reliable repair was effected by scientific welding and no further trouble has been experienced with this crank-chamber. (A "Barimar" repair.)

All manner of severely damaged gear wheels are restored; some are small whilst others are many feet in diameter, some 8 ft wheels being handled recently. Teeth that have been broken away are built up afresh on the old roots and then precision cut. Some of this work is received from overseas; in fact, British welding which is regarded as the finest in the world, is an export of some importance. Even when a double shipment is involved welding is often well worth while, for large parts are generally on their return voyage within a week of being received.

By no means all the work undertaken concerns repairs, for much of it involves alteration and modernization. Sometimes vessels used for processing are lined with stainless steel. This is done by welding in position a series of carefully shaped stainless steel strips using electrodes of the same material. When the work is finished off, the seams are invisible and the lining is in every way equal to a vessel made of one or two sections only, but the difference in cost is very great.

There are occasional circumstances in which heat may not be applied. Even this drastic condition does not rule out a sound repair, for a cold process, known as metal "stitching," can be used. The resultant strength meets all requirements fully.

For maintenance and repair needs, the resources offered by scientific welding specialists are not always realised and in the concern of an emergency breakdown the best means for solving the problem can be overlooked, particularly when time is the essence of the situation. Certainly welding is unequalled in the speed and permanency with which it can cope with mechanical failure nor is there any other method which costs less.

## BREVITIES

**Sugar factory for Malaya**[1].—A new sugar factory is to be erected at Petaling Jaya, in Malaya. The cost of the equipment will be about £5 million.

* * *

**Sugar refinery for Nicaragua.**[2]—A sugar refinery is to be erected in Chinandega by Empresa Refinería Nicaragüense de Azúcar, benefiting from a law to protect and encourage industrial development.

[1] F. O. Licht, *International Sugar Report*, 1960, **92**, (Supp. 13), 155.

[2] *Fortnightly Review* (Bank of London & South America Ltd.), 1960, **25**, 1079.

# TRENDS AND PROSPECTS OF WORLD SUGAR CONSUMPTION

By A. VITON and F. PIGNALOSA

*Condensed from* F.A.O. Monthly Bull. Agric. Econ. Stat., 1960, **9**, (1) and (2).

ONE of the most significant developments of the post-war world agricultural economy is the growth in production and consumption of centrifugal sugar. During the Second World War production fell by 20% and in 1945/46 it was only 18 million tons; the pre-war average of 24·6 million tons a year was not regained until 1947/48. However, since then the progress of production and consumption has been more rapid than that of any other agricultural commodity.

Until 1959, consumption kept pace, generally speaking, with the growth of production. World stocks rose by almost 2 million tons (25%) in 1954, when production jumped by 3·8 million tons. But the growth of consumption reduced stocks during the subsequent two years, although average production was some 700,000 tons higher. Between 1952 and the last part of 1958, the growth in consumption not only absorbed the 15 million ton increase in production but several hundred thousand tons more which were withdrawn from stock.

In 1958, the world consumed approximately 44·5 million tons of sugar, which was 16·7 million tons more than in 1949, and 20·4 million tons (85%) above average pre-war consumption. In one decade world consumption rose by 60%, or at an annual rate of 5% (compound rate of increase). Exclusive of the U.S.S.R., Mainland China and India, consumption rose in the rest of the world from 20·7 million tons before the war to 35·7 million tons in 1958, or by 72%. This is a tremendous rate of growth, and much greater than for all other foods.

The record is equally impressive if consumption is adjusted to population growth. Per caput consumption of centrifugal sugar doubled during the first 30 years of this century (total consumption increased by about 200%). It declined during the decade of the depression, and there was a further decline during the forties. The net increase in per caput consumption during the first half of the century was about 100% (although total production rose from 8 to 29 million tons), equal to an annual rate of 1·5% (compound). But during 1950/58 per caput consumption advanced by 31%, or at annual rate of 3·5 %.

Obviously, the rate of growth has not been the same in all parts of the world. The change in the pattern of growth as compared with the pre-war period is both interesting in itself and of much importance for the future development of the world sugar economy. But it is necessary to emphasize that, notwithstanding the remarkable expansion of consumption during the last ten years, the average per caput consumption in 1958 for the whole world was less than 16 kilograms, as compared with around 50 kilograms in the high-consuming countries.

Since 1940, the greatest consumption growth has been in Latin America, the Near East and Africa. Total consumption in these areas has tripled, and per caput consumption has doubled. At the outbreak of the Second World War, the ten high-consuming countries of North-western Europe, the United States, Australia and New Zealand accounted together for 52% of world usage of centrifugal sugar; in 1958 their share was only 39%. In these countries, total consumption has barely kept pace with population growth.

In Asia, sugar consumption did not rise above the pre-war average until 1952, but subsequently the percentage growth in the Far East (exclusive of Mainland China) was among the highest in the world.

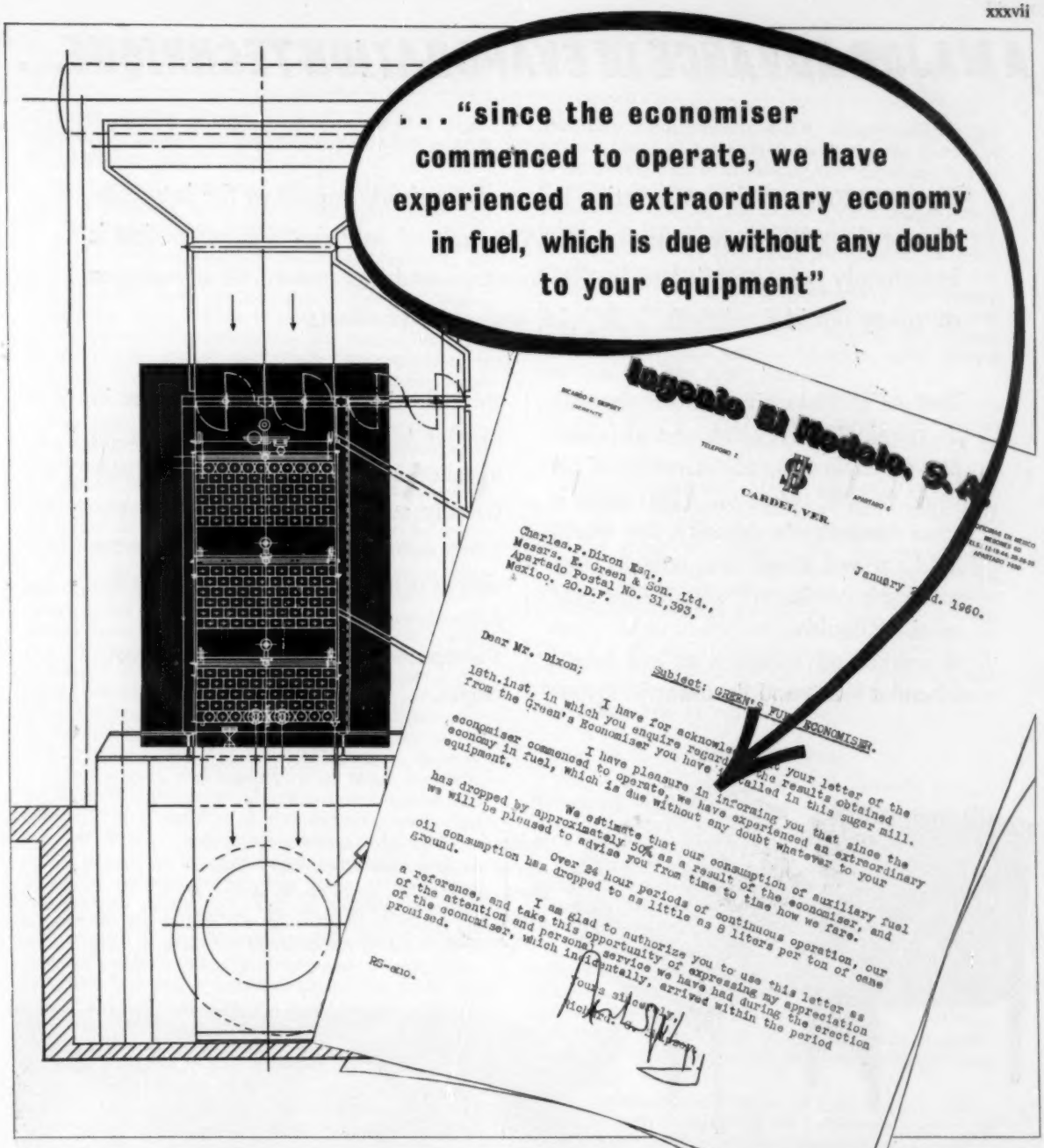
The U.S.S.R. and Eastern Europe made notable progress between 1949 and 1952. This was followed by a period of stagnation, due in part to unfavourable climatic conditions which reduced production. A new period of expansion began in 1955, which is likely to gain momentum during the next five to ten years.

In Mainland China, on the other hand, per caput consumption is still the lowest in the world. It was about 1 kilogram per caput of population before the war, and it was still 1 kilogram in 1957. Ambitious plans for wide expansion of production have been announced but to raise per caput consumption by 1 kilogram requires supplies (production or imports) of about 700,000 tons, which indicates the magnitude of the task.

The growth of consumption in the post-war period in low-income countries has made the distribution of sugar consumption much less unequal than it had been before 1940. This development is most important. The evidence suggests that the course of sugar consumption follows two fundamental trends, the effects of which are to reduce inequality of distribution, as follows:

1. In low-income countries, sugar is one of the first foods to respond to a rise in income. The response of sugar to income growth appears to be greater than that of nearly all other foods.

2. At the other extreme of the income scale there seems to be, under present dietary and other habits, an upper limit to sugar consumption of 50 to 60 kilograms per caput. At the highest levels of income,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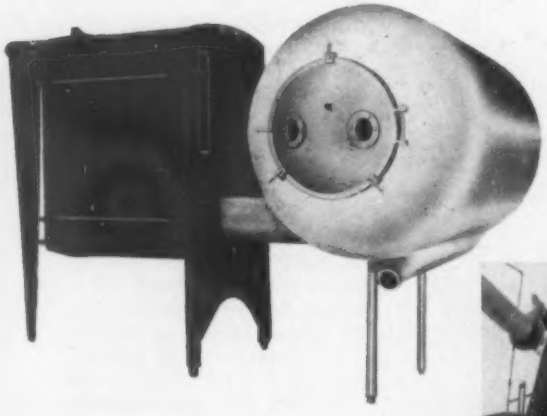
Publication No. A335 gives full particulars.



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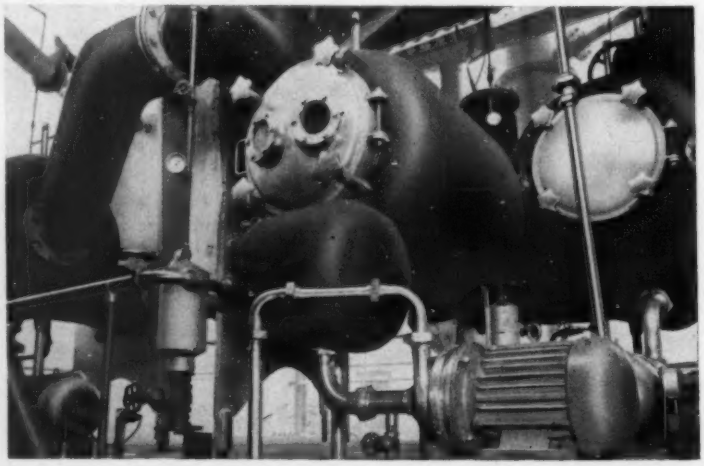

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the consumption of sugar may even show a slight tendency to decline, as demand is switched to protein foods of low caloric value.

Sugar may be consumed either directly or in the form of processed foods containing sugar. Very little is used for non-food purposes.

In the low-consumption countries, practically all the sugar is used in direct form. Incomes are too low to permit much consumption of high-cost, sugar-containing foods. Even in the United Kingdom—one of the wealthiest countries—the income elasticity of demand for cakes, marmalade and chocolate, as a group, is in the area of 0·4–0·6, while for sugar alone the elasticity is below 0·2.

The percentage consumed in direct forms rises progressively with rising income and increasing total sugar consuption. This is important both from the standpoint of marketing and from the standpoint of price policy. It is doubtful whether per caput consumption of over 40 kilograms a year can be maintained by household consumption alone.

In all the high-income countries for which data are available, consumption in indirect forms has in recent years increased more rapidly than consumption in direct forms. As might be expected, the change has gone furthest in the United States. Household consumption there fell from 72% of the total per caput consumption in 1929 to below 50% in 1957, while the total per caput consumption fell from 51 to 46 kilograms. In 1938 direct consumption in the U.K. accounted for 54% of total domestic usage of 2·3 million tons, and manufacturing usage for 46%. By 1958 the percentage of home consumption had fallen to 50·6% and that of manufacturing usage had risen to 49·4%.

The change in the pattern of consumption from direct to indirect forms may have certain price implications. In the first place, it probably accounts in part for the fall in the price elasticity, since the cost of sugar is generally a small part of the cost of the final product. On the other hand, ultimate consumption becomes a function not of the price and income elasticities of sugar but of the sugar-containing products which are of relatively high price elasticity.

## Sugar Prices

The outstanding feature of retail and wholesale prices of sugar throughout the world is the magnitude of the variation between countries. Equally significant is the great deviation in the majority of countries from the "world prices".

The difference between the lowest-price countries (Chile, Peru, British Guiana, Mauritius, with prices below 10 U.S. cents per kilogram) and the highest-price countries (Turkey, Korea, Yugoslavia, with prices of 50 to 80 cents) is partly explained by the vagaries of official exchange rates. Yet the range in retail prices remains very great, even after due allowances are made for conversion anomalies.

The explanation lies, of course, in the great diversity of taxes, customs duties, administrative regulations and other arrangements which directly affect sugar prices. Costs of production (both on the farm and in the factory) and of marketing also vary considerably between countries, but these differences are small by comparison with the 700 to 800 %difference in actual prices. In the overwhelming majority of countries, the range of 15–20 U.S. cents per kilogram at retail amply covers the hardcore cost of production and distribution. The extent of government intervention has tended to increase during the past decade, and changes in the structure of controls have seldom been such as to facilitate imports from the world market and lead to lower retail prices.

One way of measuring the meaning of changes in the retail price is to deflate the current price by the national cost-of-living index, or by the cost of all other foods.

Using this criterion it is seen that since 1938 sugar has become cheaper relative to all other foods in 38 countries out of 50, and more expensive in 11. In the first group of countries, the weighted average "real" price of sugar in 1957 was 22% lower. In the group of countries in which sugar was relatively more expensive, the average increase was 21%. The average "real" price for all of the 50 countries—which account for 72% of world consumption—was 11% below 1938. In many countries the "real" price was less than half of pre-war; in 20 countries it was at least 25% lower than in 1938.

## Other Factors

That price and income are not the only factors influencing sugar consumption is obvious *a priori* and is confirmed by correlation studies. But to isolate the other factors and to assign specific values to them is exceedingly difficult. For individual countries, detailed marketing studies offer the most fruitful approach for evaluating the precise importance of the various other factors.

A country's pattern of consumption is of course influenced by custom, habit and tastes. The efficiency of the marketing organization and transport systems are also, obviously, significant influences. Consumption cannot be very high if sugar is unobtainable—or only at very high cost—in remote villages and hamlets.

One standard explanation of consumption differences between countries is the "climate theory". It has been argued that northern countries have a higher per caput consumption because cold weather calls for greater consumption of high caloric foods. On the other hand, peoples of tropical and semi-tropical climates need less high-energy foods and consume less sugar. Again, it has been argued that there is a reverse relationship between consumption of fresh fruits, fruit drinks or wine, on the one side, and sugar, on the other. Also, it has been stated that high sugar consumption fits a bread diet but is less in accord with a predominantly rice diet.

To test these various "theories" regression analyses have been carried out in which temperature, sugar/

bread or sugar/rice price ratio and the consumption of fruits and vegetables, cereals and wine were brought in as additional variables.

With the exception of fruit and vegetable consumption, variations in the additional variables did not contribute to explaining variations in consumption. Moreover, there was, in most cases, a high intercorrelation between income and the additional variables, which might in part explain the emergence of the various "theories".

## Outlook for 1965/70

The future trend of sugar consumption depends in the first instance on the general world economic development, which will determine the course of per caput income. In particular, since the response to income changes is smaller in high-income countries than in low-income and low-sugar consumption countries, it will depend on the tempo of economic development in the latter type of country. In 1957 about 1250 million human beings, outside of Mainland China, U.S.S.R. and Eastern Europe—or 68% of the 1850 millions in the non-Communist world—were in countries where the per caput income was less than 300 U.S. dollars and where average per caput sugar consumption was less than 20 kilograms.

Equally important, as the correlation analysis has demonstrated, is the price factor. Changes in the two components of the retail price of sugar have to be examined in analyzing the potential changes in the price of sugar in relation to other foods: (1) changes in production and distribution costs; and (2) changes in legislative and administrative measures affecting the rate of taxation and other financial imposts.

As to the first, it is probable that the downward trend of the past few years will continue and on this account sugar will become slightly cheaper relative to other foods, but not by much.

Much greater are the potentialities for reducing prices through legislative and administrative measures. In 1957, only 32 countries, which accounted for 15·7% of world sugar consumption, had retail prices below 18 U.S. cents per kilogram; the 20 countries with retail prices below 16 cents per kilogram accounted for only 8% of world sugar consumption. In all other countries, financial imposts of various sorts raised prices 50 to 200% above the price range that is indicated, assuming relatively efficient production and distribution costs. The depressing effect of taxation on consumption is the greater, since the higher prices are generally to be found in low and very low income countries, where the price elasticity is considerable, often above unity.

Finally, assumptions have to be made with regard to the impact of other factors. Since many of those factors do not operate in a consistent predictable manner, forecasts are based on the assumption that "everything else (other than price and income) remains constant". But structural changes have taken place in the past, and it can be assumed that some structural changes will take place in the future. Special campaigns to promote sugar consumption, adverse dietary publicity, changes in marketing and distribution systems, so as to assure that adequate supplies are always available in all remote areas—any of these, and many other factors, could fundamentally affect the consumption pattern of a country. Some of these factors are related to, or find expression in, the trend of economic development. A continuing rise in per caput income, for example, is likely to be related to improvement in transportation facilities and the "infrastructure" of the country. The immediate effects on sugar consumption of building a road in parts of a country which had been open only to mule tracks or human carriers is very much greater than an increase in consumption that could be anticipated as a result of the slight increase in per caput income in the period. Nevertheless, the impact of these factors on the consumption development of the world is not likely to be very great, although they can be of considerable importance in any one part of a country.

Three estimates of consumption in 1965 and 1970 are presented in the table. The first estimate is a simple extrapolation of the linear trend of the total consumption from 1951 to 1957, using the least square method. The two other forecasts are based on the equations developed by statistical examination of multi-country data.

**Estimates of World Consumption of Centrifugal Sugar, 1965 and 1970**

| *Type of estimate* | 1965 | 1970 |
|---|---|---|
| | *Million metric tons* | |
| 1. Trends of total consumption .. | 56·8 | 65·8 |
| 2. Multicountry equations: | | |
| (*a*) all logs ..... | 55·6 | 66·1 |
| (*b*) semilogs ..... | 58·1 | 69·4 |
| Average estimate ..... | 56·8 | 67·1 |
| Deviation from the extreme .... | 4·5% | 5·5% |
| Maximum deviation from the average | 2·2% | 3·4% |

of multicountry data. Estimates 2(*a*) and 2(*b*) assume a population increase of 1·45% per year, a per caput real income increase of 3·1% per year (as it was for 42 countries between 1951 and 1956) and a constant real price, i.e., no change in the world price and no changes in existing taxation polities or marketing charges which affect retail prices. However, as other sources of tax income become feasible as a result of economic development (such as profit and income taxes), it may be possible to reduce direct taxation on the consumption of sugar and other essential foods and effect substantial price reduction.

The results of the three different calculations are not far apart. They indicate that during the next seven years world consumption of centrifugal sugar is likely to increase, on the basis of the assumptions with regard to population, price, and incomes, by almost 30%, or at an average annual rate of 3·6%. By 1970, world consumption should be 50% higher than in 1958, which equals an average annual rate of growth of 3·5%.

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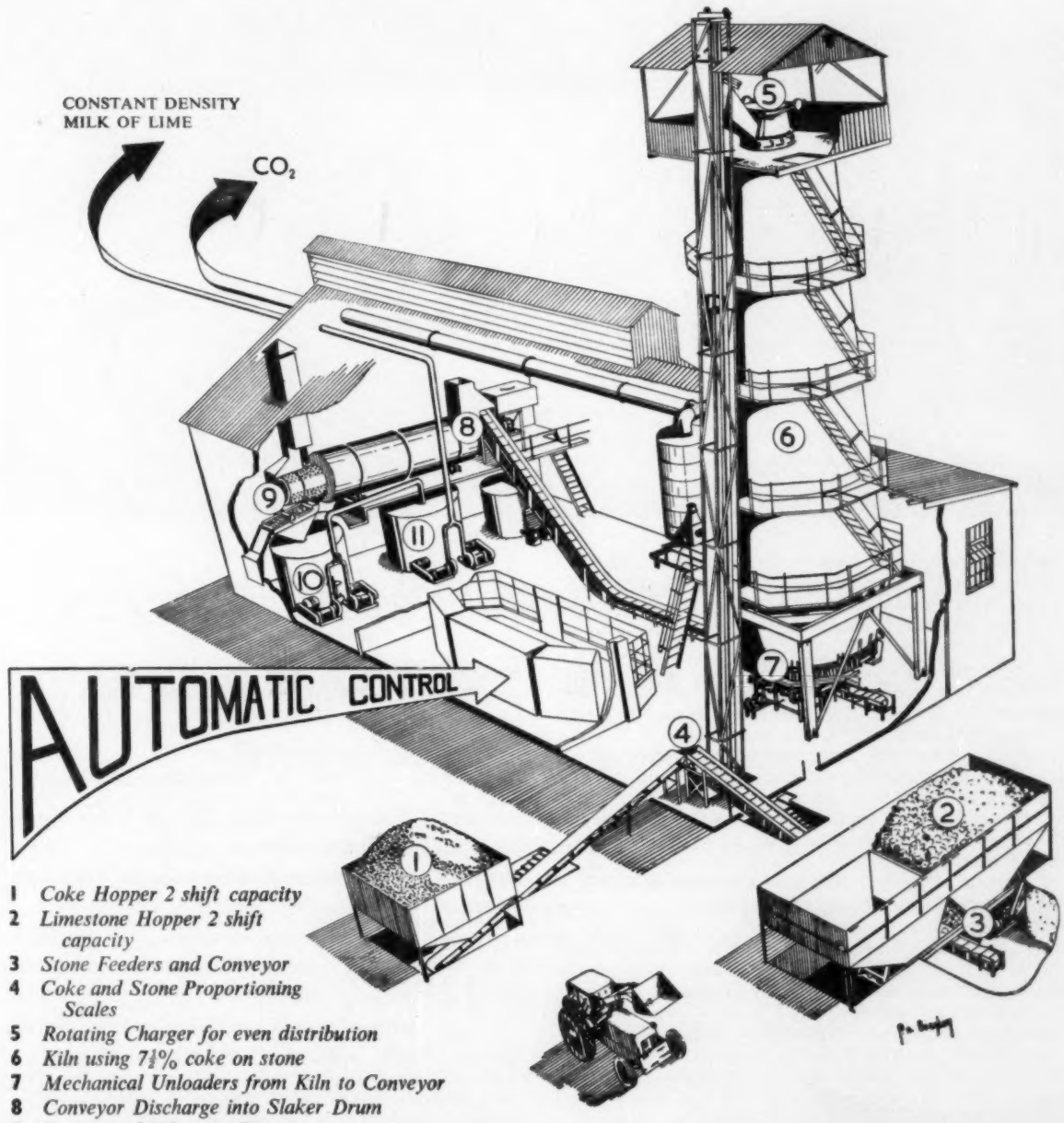


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**The economic usage of petroleum products in the sugar industry.** A. N. C. INCE. *Jamaican Assoc. Sugar Tech. J.*, 1958, **21**, 39–41.—The replacement of bagasse as boiler fuel by oil is discussed and other applications of petroleum products in the sugar factory (as diesel fuel and lubricants) are mentioned.

* * *

**Boiler No. 15 at Central Romana.** P. M. GRAHAM. *Jamaican Assoc. Sugar Tech. J.*, 1958, **21**, 41–49.—The construction and operation of a boiler installed at Central Romana to burn various fuels, including residue from furfural, oil and bagasse, are described in great detail.

* * *

**A decade of sugar cane processing research.** L. F. MARTIN, W. F. GUILBEAU, C. A. FORT, E. J. ROBERTS, B. A. SMITH, E. E. COLL, J. T. JACKSON, J. J. FRILOUX and N. A. CASHEN. *Sugar J.* (La.), 1960, **22**, (11), 11–20.—A summary is given of the 10 years' research programme, details of the various aspects of which have been published previously, carried out during 1949–59 by Sugarcane Investigations, Food Crops Laboratory, Southern Utilization and Development Division of the USDA, New Orleans. The studies include clarification, cane juice composition, analysis using labelled-sugars and amino acids, and ion-exchange purification of juice and syrup.

* * *

**Improvement in mill engine speed control at Caldwell Sugar Cooperative.** V. J. BAILLIET. *Sugar J.* (La.), 1960, **22**, (11), 25–26.—See *I.S.J.*, 1960, **62**, 222.

* * *

**Homemade instruments at Glenwood Cooperative.** L. A. SUAREZ. *Sugar J.* (La.), 1960, **22**, (11), 32–33.—See *I.S.J.*, 1960, **62**, 222.

* * *

**World's 24 hour grinding record to San Cristóbal.** ANON. *Sugar y Azúcar*, 1960, **55**, (5), 45.—In one day during 1959 San Cristóbal (Mexico) crushed 16,368 short tons of cane, a world record. Mill data are given for 3 of the world's largest mills, viz. San Cristóbal, Central Jaronú (Cuba) and Casa Grande (Peru).

* * *

**Ingenio San Cristóbal's modified clarifier design.** L. C. ROJAS. *Sugar y Azúcar*, 1960, **55**, (5), 46.—Clarification difficulties at San Cristóbal were overcome by heating the juice before it enters the clarifier, changing the position of the juice inlets from the lower to the upper back end and using a weir over the complete width of the clarifier, thus ensuring even distribution of the juice near the surface. The juice is discharged through 2-inch tubes 1 ft apart running along the clarifier bottom from one end to the other. The perforated tubes discharge into a receiver facing the entire width of the clarifier discharge end. The juice from this flows through a tube connected to the outlet by a movable elbow, which allows the juice level inside the clarifier to be changed. Excellent results have been achieved, two $10 \times 13\frac{1}{2}$ ft wide clarifiers treating juice corresponding to 1,385 m. tons of refined sugar/24 hr.

* * *

**Granular carbon used at Independencia.** A. VÁSQUEZ DÍAZ. *Sugar y Azúcar*, 1960, **55**, (5), 54.—Replacing activated carbon at the refinery with Pittsburgh Coke & Chemical's granular carbon has led to an improvement in colour and quality of the sugar, a 15% reduction in the amount of filter-aid used, an increase in the number of strikes to 4, and a reduction in run-off return to the raw sugar factory without any significant increase in ash content. The revivification oven operated only during 2 complete cycles.

* * *

**Use of oligodynamic silver for control of spontaneous fermentation of juice.** E. LORENZO-LUACES. *Bol. Ofic. A.T.A.C.*, 1960, **19**, 87–92.—Laboratory and pilot plant experiments have been carried out whereby juice is passed through beds of active carbon having oligodynamic silver adsorbed on its surface. Treated and control samples of juice were left at ambient temperature in fermentation vessels and the volume of $CO_2$ produced measured at intervals. Juice treated at the rate of 4 gal/min/sq. ft. through a column 4 inches high did not exhibit fermentation for 44 hours although the control was fermenting within 8 hours. A column 6 inches high delayed fermentation up to 80 hours while no fermentation had taken place up to 104 hours after passing through a column 8 inches high. At the flow rate of 2/5 gal/min/sq. ft., a 4-inch column gave juice which did not ferment for 5 days while the 6-inch column delayed fermentation until the 8th day and juice from the 8-inch column had not fermented on the 10th day. At a flow rate of 1·5 gal/min/sq. ft. fermentation occurred within three weeks using a 4-inch column but was delayed for 8 weeks with a 6-inch column and was not apparent after 10 weeks using an 8-inch column. In the pilot-plant experiments juice was passed through a 22-inch deep and 8-inch diameter column, effluent samples being taken at intervals and kept at ambient temperature until fermentation began. With juice taken after 24 hours running, fermentation started after 13 days, while effluent collected after 32 hours running

started to ferment after 6 days. Addition of 0·1 ml/litre raw juice contaminated with "frogspawn" before passage through the column did not affect the sterilizing action; nor did the addition of pure cultures of *Leuconostoc mesenteroides* or *L. dextranicum*. Raw juice contaminated with "frogspawn," however, did not respond to the treatment. The column is easily regenerated by backwashing with water at 180°F at a flow rate of 3 gal/min/sq. ft. during 30 minutes.

* * *

**Evolution and critical examination of the continuous clarifiers.** U. VILLAR LORENZO. *Bol. Ofic. A.T.A.C.*, 1960, **19**, 93–96, 167–173, 233–9.—Comparisons are drawn between the Dorr "Primitive," "Multifeed" and "RapiDorr" continuous clarifiers, the Graver, Diazeo primitive and improved Ibáñez clarifiers, and the Bach, Pearson and Fortier clarifiers.

* * *

**The performance of sugar factories in 1959.** J. DUPONT DE R. DE ST. ANTOINE and J. P. LAMUSSE. *Mauritius Sugar Ind. Research Inst Rpt.*, 1959, 77–82.—Factory data from 24 factories are presented and modifications introduced in certain processes at some factories are mentioned.

* * *

**Power consumption of cane knives and shredders.** R. DE FROBERVILLE and J. DUPONT DE R. DE ST. ANTOINE. *Mauritius Sugar Ind. Research Inst. Rpt.*, 1959, 82–85.—Studies of the electrical power consumption of cane knives at 4 factories and of a Cail and Gruendler shredder at 2 factories are discussed. At one factory the first of 4 sets was driven by a smaller motor than the 2nd set, whereas the normal practice is for the 2nd set to have the larger motor. This was made possible by reducing the clearance of the 1st set from 9 in to 7 in, with an increase in power only from 145 to 161 h.p., thus reducing the load on the 2nd set of knives. The power consumption of the two shredders was high at 19 (Cail) and 15·1 (Gruendler) h.p. consumed per ton of fibre/hr. The former also consumed about 110 h.p. when running empty, compared with 50 h.p. for the Gruendler. Further investigations are to be made.

* * *

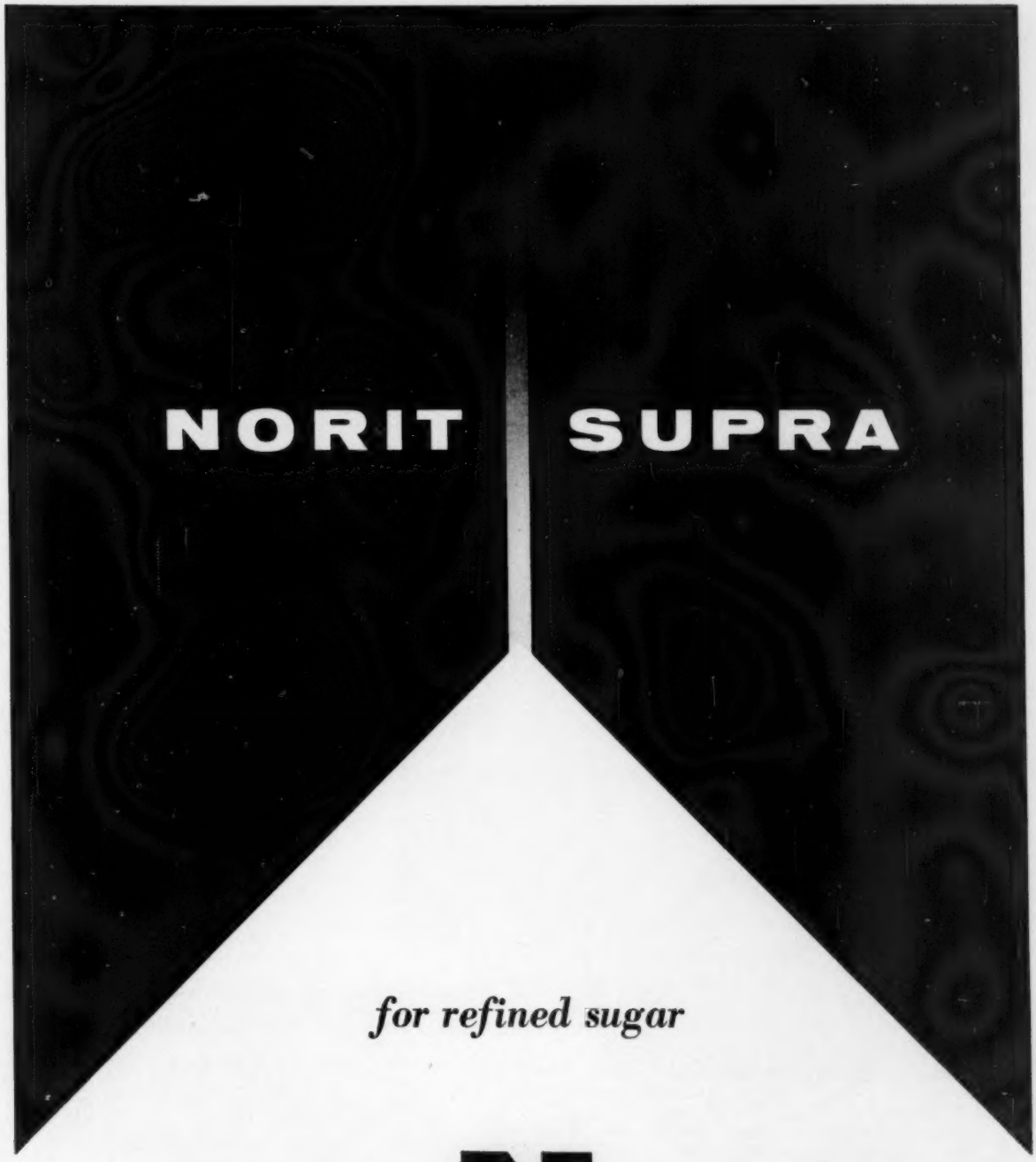
**The use of polysaccharides in cane juice clarification.** E. C. VIGNES and R. DE FROBERVILLE. *Mauritius Sugar Ind. Research Inst. Rpt.*, 1959, 85–89.—Tests with "Separan AP-30" were conducted on juice at Mon Désert-Alma and Riche-en-Eau factories. At the former factory the juices required 1·5 p.p.m. "Separan," being very refractory, and phosphoric acid was added at 125 p.p.m. to compensate for a $P_2O_5$ deficiency. The "Separan" was added at the flash tank to the hot-limed juice as a 0·125% solution. At Riche-en-Eau the "Separan" was added at 2·5 p.p.m. on mixed juice to No. 1 clarifier in one series of tests, and in a second series at 1·25 p.p.m. to No. 1, switching later to No. 2 clarifier. At Mon Désert-Alma the "Separan" was added on alternate days, as the factory has only one clarifier. At this factory a 600% increase in the settling rate was effected and at Riche-en-Eau 115–120 and 144% increase (with 2·5 and 1·5 p.p.m. "Separan" respecively). The latter's juices were easily clarified, as opposed to those from Mon Désert Alma; however, Riche-en-Eau juice clarification was not normally a problem. The pol % mud at Mon Désert-Alma was reduced by about 15% and the "Separan" did not apparently affect turbidity, although the juice turbidity was very high after treatment and accurate measurements were difficult.

* * *

**The washing of commercial sugar in centrifugals.** J. P. LAMUSSE and M. RANDABEL. *Mauritius Sugar Ind. Research Inst. Rpt.*, 1959, 89–93.—Tests were carried out to determine which system of washing (i.e. saturated steam or superheated water) is best suited to Mauritian conditions. Details are given, and from the results it is concluded that for the same sugar pol the two methods give the same moisture content and runnings of about the same purity, although superheated water is preferable as more even spraying is obtained and the sugar does not cake. The later the water is introduced, the higher the sugar pol, although the moisture content of the sugar is apparently not affected by the time of application.

* * *

**Fully-automatic sugar centrifugals.** W. SCHERER. *Zucker*, 1960, **13**, 278–281.—The development of the fully-automatic centrifugal is discussed, and particularly the choice of time-dependent *vs.* speed-dependent controls. The importance of friction in charging times exceeding 25 sec is mentioned. Operational defects caused by excessive oscillation can be prevented by means of the Siemens-Schuckertwerke magnetic control. This consists of two measuring coils which are adjusted to 10 mm either side of the centrifugal spindle; any oscillation is thus detected and countermeasures can be adopted. Tests at Ochsenfurt factory have proved satisfactory, deflections of 1/10 mm being easily detected. Where the centrifugal speed required does not correspond to a synchronous motor speed, e.g. 1200 r.p.m., maintenance of this speed throughout curing means that there is no cut in the power consumption of a D.C. motor equipped with a Leonard control. On the other hand, a 4-pole motor of 1500 r.p.m. can be run so that there is some saving, e.g. when the speed drops slightly from 1250 to 1150 r.p.m. during curing of white sugar and middle-product massecuites. This is not applicable to the curing of low-product massecuites, where the curing time is much longer. The motors cannot be protected against overloading by a bi-metal relay, as normally with electric motors, although a "thermo-release" developed by Siemens-Schuckertwerke ("Sensotherm") built into the motor has proved satisfactory in registering the curing time and current peaks and thereby increasing the life of the motor. Special relays are also mentioned for motors without thermo-control which prevent single-phase running of the motor as a result of undetected fusing and thus prevent overloading.

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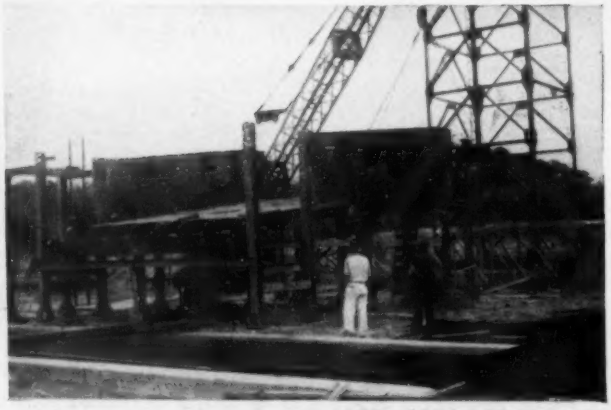

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**Results of auto-analysis at Sucrest refinery.** J. K. T. CHANG. *Sugar y Azúcar*, 1960, **55**, (6), 25–26, 41.—The sugar losses in water at Sucrest refinery were determined with an "Auto-Analyzer"[1]. It was found that the highest losses occurred in the condenser water and the press slurry. Graphs are presented of sucrose concentration *vs.* time of recording for pan and clarifier condensate lines, and exchange resin sweetening-off water. The time taken to wash the press slurry is also demonstrated graphically.

* * *

**Calculation of the efficiency of individual mills in a tandem.** G. R. ROELEVELD. *Sugar y Azúcar*, 1960, **55**, (6), 27–29, 41, 45.—Equations are derived and a graph presented for determination of the apparent efficiency of mixing maceration liquid and bagasse, and of the separation of bagasse from the maceration liquid.

* * *

**Device for automatically controlling and regulating the boiling of refinery massecuites.** E. A. GUSEV. *Sakhar. Prom.*, 1960, (5), 29–35.—The device consists of a programme regulator which controls the air line feeding the pneumatically-controlled sugar seed and syrup feed devices. The regulator is programmed to determine the angle of slope of the supersaturation curve based on extensions to DÜRING's law, whereby the slope of any supersaturation curve, which is a straight line when drawn on a graph of b.p. of water *vs.* b.p. of sugar solutions at identical pressures, is constant for the b.p. of a sugar solution at a given supersaturation, within the limits of temperature, pressure and purity experienced in the sugar industry. The measuring system of the device determines the slope of the supersaturation curves by measuring the b.p. of water in a control vessel and the b.p. of the massecuite in the pan at identical pressures. The two impulses generated by a special mechanism are resolved into an angle of slope of supersaturation curve, dependent on the degree of supersaturation of the solution at a given syrup purity. The needle is set at a supersaturation by the pan-man, who pours some seed into the hopper. When that supersaturation is reached, the seed is automatically fed into the pan, and a red light flashes. Thus nucleation of all the required amount of crystal simultaneously under optimum conditions. All further control including syrup feed and tightening up is remote. In comparative tests the instrument gave slightly higher reading than values obtained analytically. After the first syrup drinks, until the end of boiling, the difference increases linearly as boiling proceeds, so that a correction factor may be easily calculated.

* * *

**Chemical treatment of fuels to increase combustion efficiency.** J. B. KHU. *Proc. 6th Conv. Philippines Sugar Tech.*, 1958, 150–154.—The benefits to be gained by using "combustion catalysts" are discussed with details of two case histories.

**Industrial process control instruments for sugar factories.** E. F. GAMBOA. *Proc. 6th Conv. Philippines Sugar Tech.*, 1958, 130–135.—Process control by instruments in the sugar industry is discussed with a description of the proposed control scheme for the affination station of Victorias refinery, whereby the flow of affination syrup to the raw sugar in the mingler is to be regulated, based on addition of syrup to maintain a pre-set ratio of syrup: raw sugar weight and thus magma Brix. Other process controls are enumerated.

* * *

**A review of bulk handling of raw sugar in Australia.** E. R. DE LUZURIAGA. *Proc. 6th Conv. Philippines Sugar Tech.*, 1958, 136–142.—A brief description is given of the installations at the C.S.R. refineries and a more detailed account of the bulk loading terminal at Mackay, etc.

* * *

**The new 3-boiling system using A-molasses granulation.** D. E. BATENGA and P. H. SING. *Proc. 6th Conv. Philippines Sugar Tech.*, 1958, 203–211.—See *I.S.J.*, 1958, **60**, 237.

* * *

**The effect of concentration and non-sugars in crusher juice in processing operation.** F. V. DEOMANO. *Proc. 6th Conv. Philippines Sugar Tech.*, 1958, 212–220.—Tables are presented (1) for the Philippine mills showing the average non-sugars in juice during 1953/54 – 1955/56 inclusive; (2) for 4 mills from Negros and from Luzon of approximately identical capacity and with about the same factory equipment, but milling different quality cane during 1956/57 and 1957/58; and (3) for one Luzon central, showing the average non-sugars in crusher juice before the war, when good quality cane was milled, and after the war, when low quality cane was processed. The data presented in the tables show that those mills processing poor quality cane with high non-sugars content in juice produced more molasses, had lower actual sucrose recovery on cane than the theoretical based on a common sugar distribution table, and had a lower "efficiency distribution factor" than centrals processing good cane.

* * *

**Filtration theory and its application to the carbonatation process cane and juices.** B. B. GAIROLA. *Indian Sugar*, 1960, **10**, 47–52, 58.—Theoretical equations are derived and carbonatation juice filtration discussed theoretically with the effect of the variables involved. Sample calculations are presented, demonstrating that using a cake thickness of 1 inch instead of ¾ inch reduces the capacity of the filter-press station by 15%, although labour is saved by the same percentage. However, in view of the labour conditions obtaining in India, it is considered preferable to maintain the lower cake thickness.

[1] *See I.S.J.*, 1960, **62**, 133.

**Formation of calcium trisaccharate.** P. V. GOLOVIN, A. A. GERASIMENKO and G. S. TRET'YAKOVA. *Ukrain. Khim. Zhurn.*, 1959, **25**, 781–785.—In tests it was found that addition of freshly calcined lime dust to a solution of soluble saccharate or to an aqueous sucrose solution effected a greater precipitation of sucrose as calcium trisaccharate than did milk-of-lime or slaked lime, under identical conditions. If less milk-of-lime is added than is required for calcium trisaccharate formation and the remainder of the required lime is in the form of dust, the amount of Ca trisaccharate precipitated is the same as if only lime dust were added. This method is recommended, as thus the consumption of lime dust can be cut by 25%. It is suggested that sucrose must first be liberated from the coat of hydrate water by reaction of the latter with the lime before the sucrose can combine with lime. When slaked lime or milk-of-lime (100–125% on weight of sugar) was added to sucrose solution, the amount of sucrose precipitated was 8–14% by weight of the original sucrose content, as opposed to about 90% when lime dust was added, which reacts vigorously with the hydrate water, unlike the milk-of-lime which cannot destroy the hydrate water coating so easily.

* * *

**Corrosion protection in the sugar industry.** W. KINDSCHER. *Zucker*, 1960, **13**, 317–318.—Application of a double-component synthetic resin paint manufactured by Schering A.G. with and without solvent as well as mixed with quartz sand to the basin of a pulp press, the concrete floor of a raw sugar warehouse and to iron and concrete flumes has proved successful in combating corrosion.

* * *

**A new J-diffuser at Sarkad sugar factory.** K. LEELÖSSY and K. VUKOV. *Zeitsch. Zuckerind.*, 1960, **85**, 298–299.—The major modification in the J-diffuser is the location of the control station on a level with the cossette feed, so that one operator can now supervise the whole plant. Some performance data are presented, including losses (0·29% on beet during 1959/60 at 122·6% juice draught).

* * *

**Purity control of boiler feed water with the interferometer and high frequency measurement of the conductivity.** G. ZIEGLGÄNSBERGER. *Zuckererzeugung*, 1960, **4**, 182–183.—Determination of the sugar and accompanying electrolyte in boiler feed by means of a Zeiss interferometer and an oscillator at 40 mc/s is discussed as an alternative to the α-naphthol test. A recorder graph is presented.

**New machines and devices for mass testing in the beet laboratory.** W. WÖHLERT. *Zuckererzeugung*, 1960, **4**, 173–175, 179.—New equipment developed at the Kleinwanzleben Institute for Plant Breeding, German Academy of Agricultural Sciences, Berlin, is described and illustrated. It includes a beet washer and drying plant, centrifuge, burette for lead acetate digestion, conductimetric equipment for soluble ash determination, and instruments for determination of the noxious N content using the 'blue number' method.

* * *

**Material and time costs of filtration with rotary filters.** W. EWERS. *Zuckererzeugung*, 1960, **4**, 184–185.—The production costs at Haldensleben, which has used rotary filters since 1957, are discussed. The filters have worked satisfactorily and 17% more beet has been processed than during the longest campaign before the changeover from filter-presses. Further improvements may be brought about by lengthening the life of the filter cloths and of the rubber parts.

* * *

**A technological scheme for juice purification.** I. M. LITVAK. *Sakhar. Prom.*, 1960, (6), 20.—It is considered preferable to heat raw juice after pre-liming and not before, when 1st carbonatation juice is returned, since the muds in the juice mixture will prevent rapid scaling of the juice heaters. The use of further filtration after 2nd carbonatation filters, once necessary where sulphitation was not carried out, is now superfluous in the standard scheme, mechanical filters only, after the sulphitation plant, being required.

* * *

**A scheme for preparation of water for diffusion.** G. S. BENIN. *Sakhar. Prom.*, 1960, (6), 21–24.—A scheme is described for ion exchange treatment of ammoniacal water used in diffusers. The water, with an average ammonia content of 0·015% and a pH of 9·0–9·3, is treated at 80°C with a strongly acidic cation exchange resin with a capacity of 4·5 meq/g to remove the ammonia. The resin is regenerated with a 0·5% of sulphurous acid. As the pH of the treated water will be 4·7–5·5, a quantity of untreated ammoniacal water should be added sufficient to raise the pH to 6 for diffusion. A diagram is presented of the proposed scheme, illustrating the two exchange columns to which flow the ammoniacal water from the condensate tanks and the sulphurous acid from the sulphitation tower, both under gravity. Calculations of the required amounts of water, exchange

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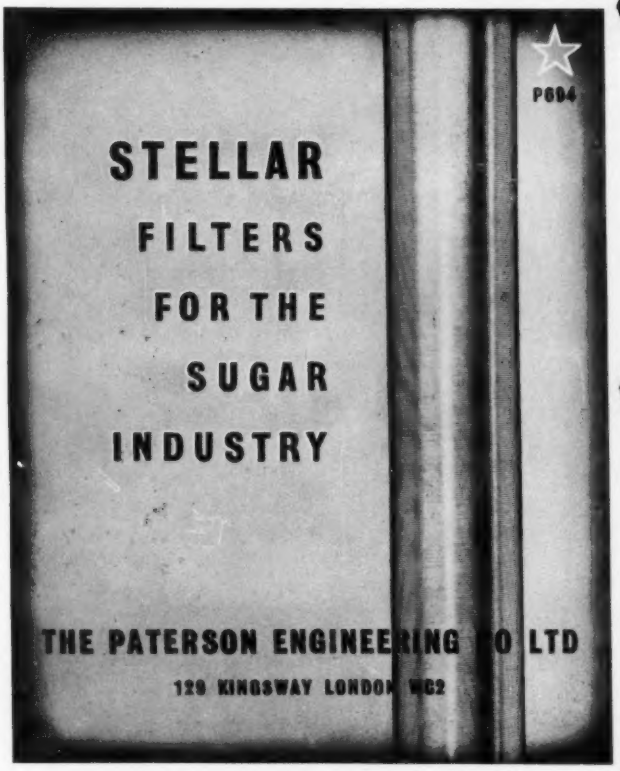


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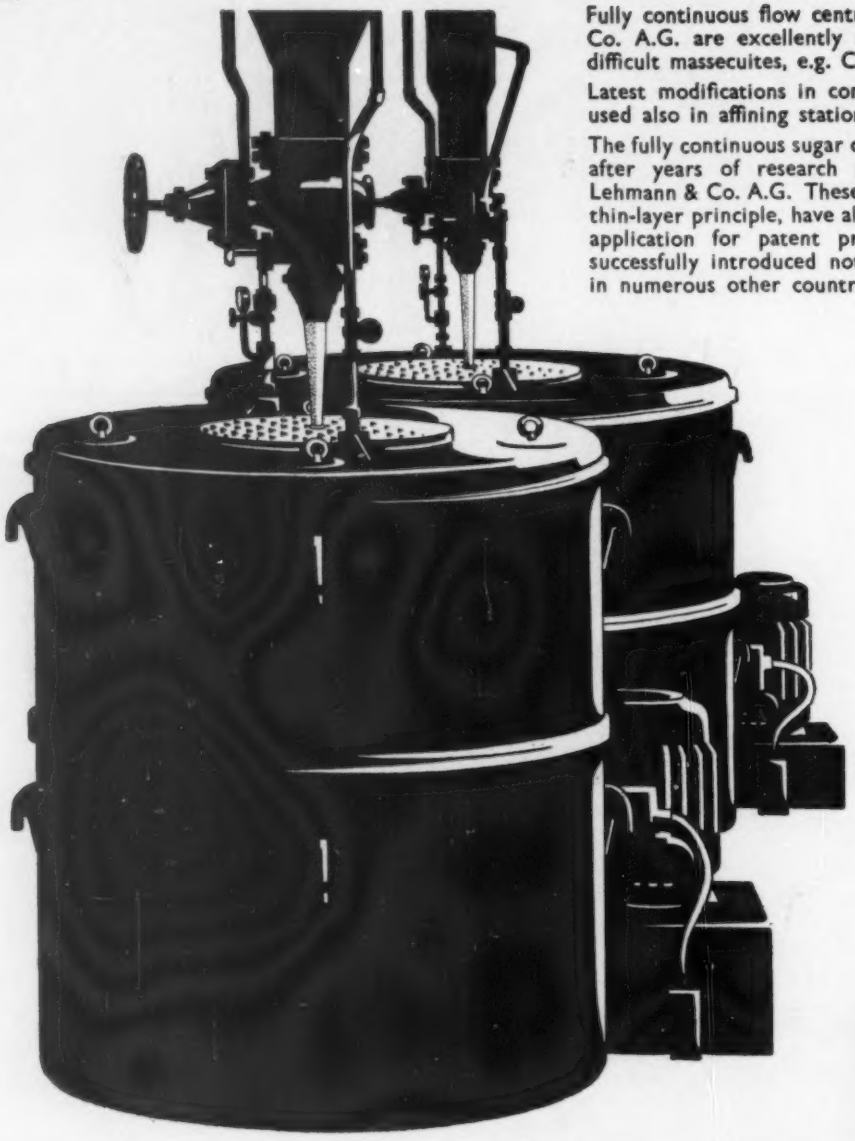

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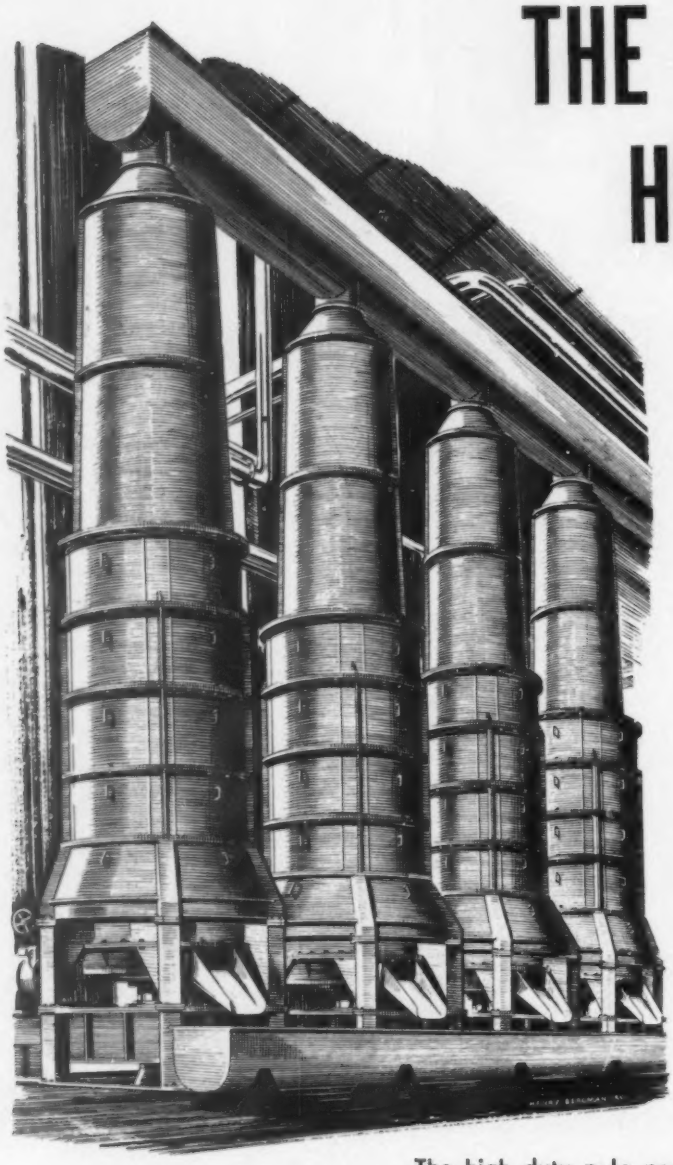

**gives**

a great output of pressed pulp with high dry matter content.

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British patent nr 803, 216
Other patents applied for.

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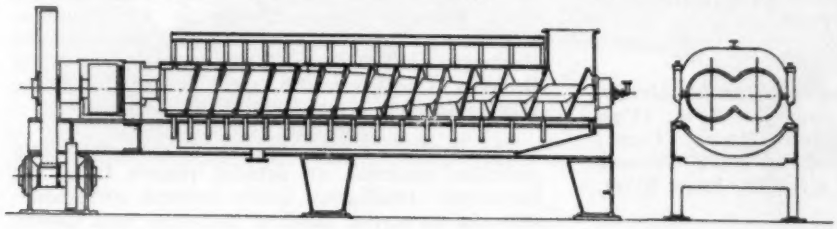
resin, and sulphur are based on the requirements of a factory with a slicing capacity of 2500 tons/day. The exchange cycle from regeneration to regeneration is 40·3 hours.

* * *

**Further notes on pulp pressing and pulp press development.** S. A. MORRISH. *Paper presented to the 13th Tech. Conf., British Sugar Corp. Ltd.*, 1960.—Following very promising results obtained with the Stord B.S. 35 press at Peterborough factory, reported at the 12th Technical Conference[1], the largest size of the type, the Stord B.S. 64 press, was installed in battery with existing Paschen presses. It was estimated that the press would handle 700–1000 tons of wet pulp from an R.T. diffuser per 24 hours. Records throughout the campaign show an advantage for the Stord press of 4% higher pressed pulp dry substance compared with other presses. At 4·75 r.p.m., the press handled 1000 tons wet pulp per 24 hr, requiring 60 h.p. and giving 20% dry substance; at 3·5 r.p.m. power required was the same but capacity was 750 tons/24 hr and dry substance 22%. At 3 r.p.m. throughput fell to 720 tons/24 hr but dry substance rose to 22·54%, power required being the same. With a speed of 1·5 r.p.m. power demand fell slightly, the throughput dropped to 400 tons/24 hr, but dry substance rose to 25%. The best speed range is thus between 3 and 3½ r.m.p., at which throughput is higher than any other type of press used by the Corporation and power demand is lower per ton of pulp, while the press, being totally enclosed, is clean in operation. Its internal condition after a campaign was very good as regards wear and reasonably good as regards corrosion. Full scale trials of the use of fine-hole screens supported by normal screens gave higher dry substance than normal screens, stainless steel screens being better than brass. The quantity of dry substance passed per minute by the special stainless steel and brass screens started higher than normal screen but later fell below; this may be a physical effect caused by ageing of the beet. Use of an overhead feed to a bottom-driven press, through a brass-lined chute, was successful in increasing throughput although no improvement in pressing was observed. A new type of press, designed by Rose, Downs & Thompson Ltd. is described; it has a single-double screw combination and its design especially features ease of dismantling and reassembly.



The Stord beet pulp press

**The performance of (beet) flumes.** V. N. PELETMINSKII. *Sakhar. Prom.*, 1960, (6), 31–34.—The causes of stoppages in beet flumes are discussed and recommendations offered on the dimensions of flumes, dependent on factory daily capacity, angle of slope and the so-called 'coefficient of wall roughness,' applicable to water flow, which has values of 0·01–0–04, the lowest value being given for the best plaster surface. A nomogram is presented relating angle of slope, coefficient of roughness, optimum width, water requirements % on weight of beet, and factory slicing rate.

* * *

**Evaporation of sugar solutions.** B. P. MITROFANOV. *Sakhar. Prom.*, 1960, (6), 35–38.—A descending film-type evaporator designed by S. F. ZHIGALOV is discribed with diagrams. Tests using a model have proved satisfactory, with neither stripping of the heating surface not increase in colour of the sugar solutions.

* * *

**Vacuum aspirators and their use in the sugar industry.** K. V. KRASNYANSKII. *Sakhar. Prom.*, 1960, (6), 55.—Tests conducted on centrifugal and rotary pumps in which the inlet valve was replaced by an aspirator for pumping of sweet-water overspill, oil and final molasses, have proved satisfactory. The aspirator is filled through a port with liquid, the port closed and the connexion to the pump opened, whereby the liquid passes to the pump, creating a vacuum which drains the sweet-water or other liquid from the supply tank. This arrangement obviates blockages of the pump inlet valve. The aspirator should have a capacity 5 times greater than the capacity of the feed line to the pump, and the delivery line should have the same capacity (or greater) as the aspirator. Hot molasses (35–40°C) was easily pumped from the troughs to the tanks at half the time normally taken.

* * *

**Application of control instruments for calculation of molasses.** V. I. AKSENFEL'D. *Sakhar. Prom.*, 1960, (6), 54.—Modifications to a pneumatic depth gauge for molasses tanks are discussed and a differential float-type automatic recording manometer operated by clockwork motor is described. This is mounted on the weigh platform of the scales used for weighing the molasses. As the tank is filled and emptied, so the pressure rises and falls, and gives satisfactory indication of the molasses weight to within 50 kg/day.

[1] *I.S.J.*, 1959, **61**, 339.

# NEW BOOKS AND BULLETINS

**Sweeteners for Industry.** (Brown & Polson Ltd., Wellington House, 125–130 Strand, London W.C.2.) 1960.

This book is designed by its publishers to describe the range of products made from corn and cane by the Refinery Group of Brown & Polson Ltd. and their subsidiary, George Clark & Son Ltd. This includes liquid and solid (crystalline and powdered) glucose, brewing sugars, liquid sugars and liquid glucose/sucrose mixtures, inverts, syrups and caramel, and their characteristics are described in the first of the sections into which the book is divided by coloured tabs. The next section provides, with illustrations and flowsheets, an account of how the sweeteners are made, while successive sections describe the industries served by the Refinery Group; Technical service facilities provided to assist customers in their processes and problems; bulk handling installations; special analytical techniques; and technical data—tables, graphs and calculations presenting information such as refractive indexes, solubility, Brix, freezing point depression, etc. of the various sweeteners, likely to be of use to customers. The final section gives the addresses of Registered Offices, factories and Sales Offices. There are a limited number of copies of the book for distribution. It is attractive, well-printed and will certainly be most useful as a reference work to all concerned with, particularly, liquid sugars, inverts and glucose.

* * *

**Worker in the Cane—a Puerto Rican life history.** S. W. MINTZ. 288 pp; 5½ × 8½ in. (Yale University Press, New Haven, Conn., U.S.A.: Oxford University Press, Warwick Square, London E.C.4.) 1960. Price: $5.00; 40s. 0d.

Professor MINTZ, a sociologist, went to Puerto Rico in 1948/49 to carry out field work, living in a rural *barrio* or district near a small municipality in the cane area of the south coast. The study was to be more general but became largely based on the life and history of one man, the author's principal informant and medium of introduction into village life. After a return trip in 1953 the present book was prepared and amended after a further trip in 1956, intervening events being recorded.

The bulk of the book is in the words of the Puerto Rican, DON TASO, and describes vividly the harshness of life in the *barrio* during the past fifty years, providing at the same time a picture of the changes in Puerto Rico as seen in the eyes of the manual worker. It is an interesting story which draws the attention sharply to the human effects of changing techniques such as mechanization of farming, etc., while also illustrating the dangers latent in the domination of an entire economy of a country by large impersonal organizations as in the case of the Puerto Rican sugar industry.

**The Commonwealth and Europe.** The Economist Intelligence Unit. 606 pp; 6 × 9 in. The Ecomonist Intelligence Unit, 22 Ryder Street, St. James', London S.W.1.) 1960. Price: 42s. 0d.

Britain's relationship with Europe is one of the great political issues of the present time. Agreement to form a single European market has not so far been reached, partly for political reasons, partly because of economic difficulties. Of the latter the most intricate and important for Britain concern the means of reconciling the present system of Commonwealth trade with British participation in a new economic system in Europe.

The purpose of this book is to find out, by means of detailed analysis of all available evidence, the future effects on the Commonwealth of the present moves towards freer trade in Europe, and of a possible future participation by Britain in the Common Market. These effects have been much discussed; but no one hitherto has tried to discover in detail what they will be.

"The Commonwealth and Europe" examines all the main commodities exported by overseas Commonwealth countries, including sugar, as well as the growth prospects of these countries. It also deals with the main economic issues relating to the Commonwealth, e.g. the sterling area and Commonwealth Preference, and it discusses those arrangements for Britain's Commonwealth trade which might be acceptable if the Six and the Seven come together.

The book is based on extensive research into published material, on detailed reports from The Economist Intelligence Unit's overseas correspondents and on several hundred interviews with leading businessmen and officials.

Among the book's conclusions are that:

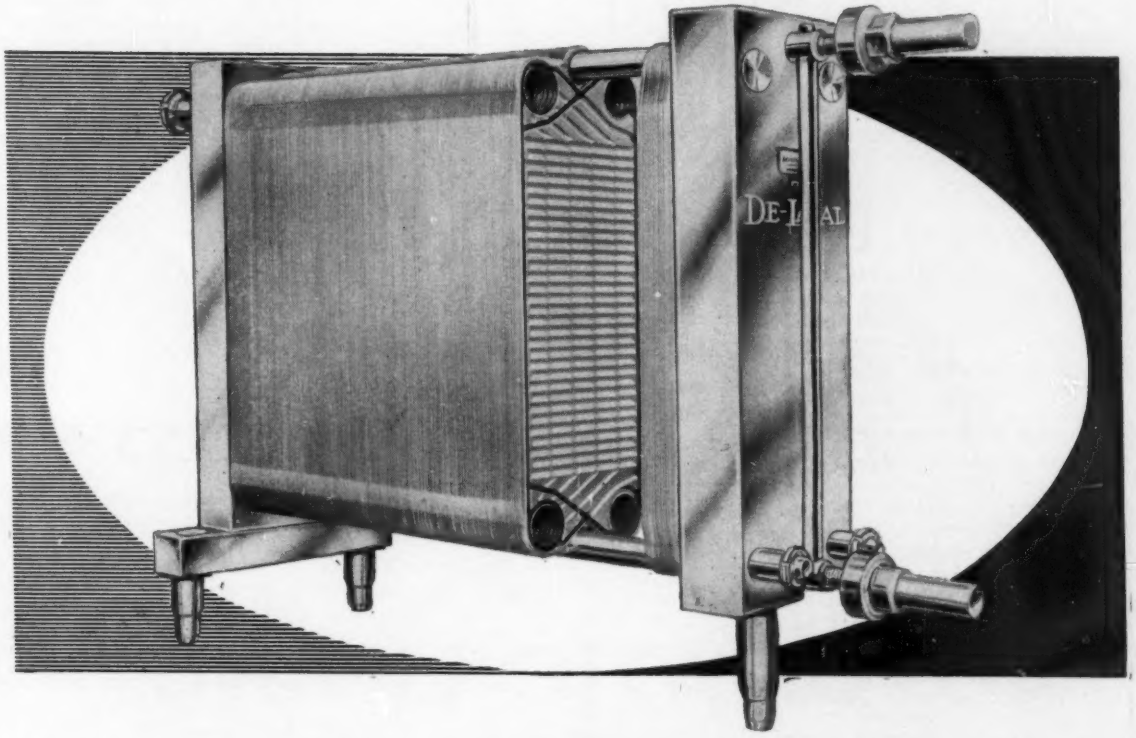
(1) the existence of the Common Market (EEC) is likely in general either to increase exports from individual commonwealth countries, or to leave them largely unaffected, apart from certain foodstuffs which are likely to suffer (these do not include sugar);

(2) if the EEC and the EFTA (European Free Trade Area) were to merge, it would be possible to arrange terms that neither violated the principles of the Common Market nor did serious harm to any substantial flows of Commonwealth trade. At the same time the Commonwealth's exports in general would benefit from faster economic growth in the UK and easier access to Continental markets, and

(3) the system of Commonwealth Preference is less important to the exporting countries concerned than the guarantee of an adequate market in the U.K.

DE LAVAL

# Plate Heat Exchangers in the sugar industry




Rationalisation in the sugar industry has in recent years paid increasing attention to the savings made through heat economy. In this field the outstanding heat transfer characteristics of De Laval Plate Heat Exchangers has been invaluable.

Several beet-sugar factories in Europe have recently considerably improved their sugar extraction by using ion-exchange juice purification. This development has been made economically practicable by virtue of heat economies made by using plate heat exchangers. Seven out of eight of the factories involved use De Laval Plate Heat Exchangers exclusively.

De Laval Plate Heat Exchangers are also being widely used for heating and cooling at other stages in the sugar manufacturing process. In addition to their exceptional heat-transfer capacity they have many other advantages which make them ideally suited to use in the production of sugar. They are strong, absolutely reliable and can be obtained with heat-transfer surfaces in the metal most suited to handling the liquids involved. Their simple construction principle means that they can easily be adapted to meet various capacity and handling requirements and that the heat transfer surfaces can be rapidly exposed for cleaning. In comparison with tube and shell types of heat exchanger of similar heat-transfer capacity De Laval Plate Heat Exchangers are remarkably compact — a factor which has meant considerable saving of floor-space.

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**Plate Heat Exchangers for industrial applications**

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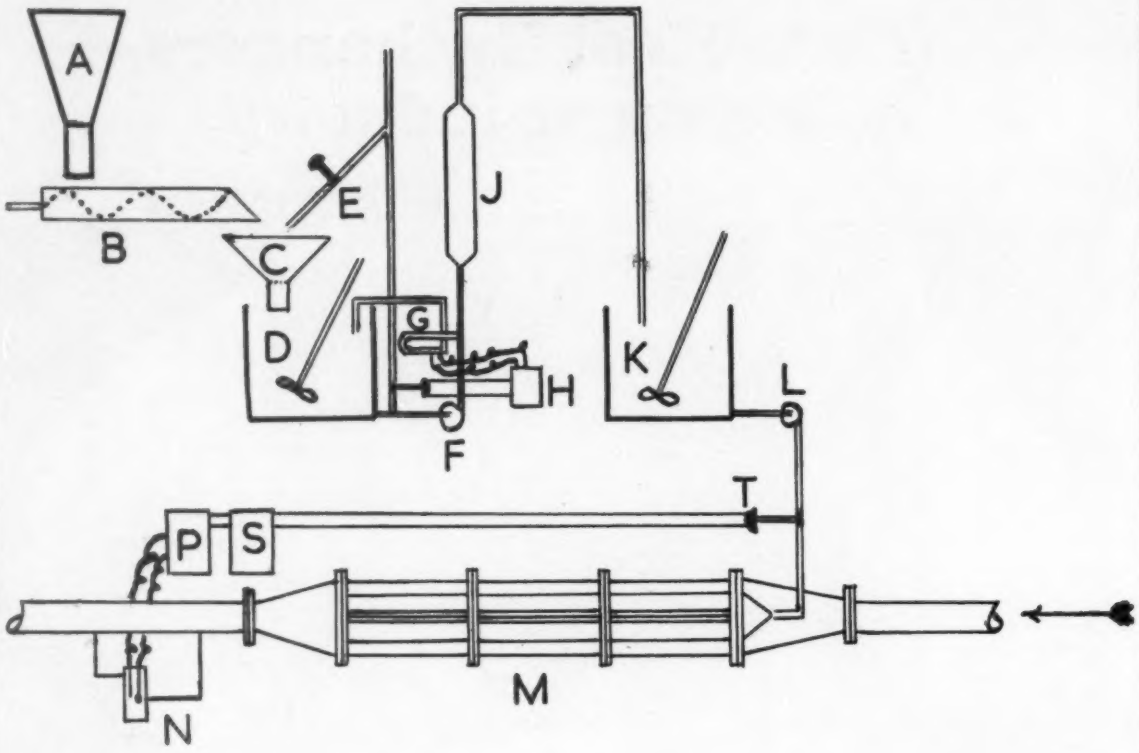



# AUTOMATIC LIMING CONTROL

KEY TO SCHEMATIC DRAWING LAYOUT

A—Hydrated Lime Hopper

B—Screw Conveyor

C—Sieve-bottom Receiver Hopper.

D—Heavy Milk-of-Lime Tank with Stirrer.

E—Hand Operated Valve on Water Line.

F—Centrifugal Pump for Heavy Milk-of-Lime to Density Meter & Controls.

G—Density Meter, Continuous and Automatic.

H—Recorder/Controller for Continuous Density Control.

J—Stand-pipe for ensuring that Meter is always full.

K—"Correct" Milk-of-Lime Tank, with Stirrer.

L—Centrifugal Pump for "Correct" Milk-of-Lime to Process.

M—Mixer Unit.* (Patent Pending).

N—Flow-through Electrode System for pH Control.

P—pH Transmitter.

S—Recorder/Controller for pH Control of Liming.

T—Automatic Valve for Controlled Addition of "Correct" Milk-of-Lime to Mixer unit.

* See *I.S.J.*, 1958, 60, 213.

**The Sugar Manufacturers' Supply Co. Ltd.**

7 & 8, IDOL LANE, LONDON, E.C.3, ENGLAND.

*Cables:* "Sumasuco, London."

# LABORATORY METHODS AND CHEMICAL REPORTS

**Development of a sugar beet processing laboratory.** A. I. MORGAN, E. J. BARTA and G. O. KOHLER. *J. Amer. Soc. Sugar Beet Tech.*, 1959, **10**, 565–570.—A small-scale plant at the U.S.D.A. Western Regional Research Laboratory for continuous processing of 200 lb beet per day is described with illustrations. The equipment includes a beet washer and cold store (1°C), a rotary drum cossette cutter and a single-scroll Brüniche-Olsen continuous diffuser comprising a trough 4 ft × 6 in, the interrupted scroll rotating at 1⅛ r.p.m. to give a retention time of 40 min. Juice passes through a modified model Dorr carbonatation plant and is filtered through paper in Buchner funnels. After second carbonatation and boiling for 3 min, it is sent to the evaporator-crystallizer, which is a vertical cylinder 4 ft 6 in high and 14 inches in dia. The syrup is either concentrated to crystallization in the evaporator, or to nearly saturated juice, which is canned and stored for further study.

* * *

**Fractionation of nitrogen compounds in beet molasses.** J. B. STARK, A. E. GOODBAN and R. M. MCCREADY. *J. Amer. Soc. Sugar Beet Tech.*, 1959, **10**, 571–577.—Dilute molasses is passed through a strongly acidic cation exchange resin in the H form which adsorbs the basic nitrogen compounds; the effluent is then passed through a column of intermediate-strength anion exchange resin in the chloride-formate form which retains the strongly acidic compounds. Nitrogen compounds in the second effluent are considered as unadsorbed. Analyses of these fractions showed that their relative proportions by weight of total nitrogen in molasses were: 66%, 28% and 6%, the latter being unidentified mainly weakly acidic compounds. Of the basic nitrogen 49% is betaine, 27% other amino acids, 7% amides and ammonia and 17% is unidentified. Of the acidic nitrogen fraction, 55% is pyrrolidone carboxylic acid, 6% amino compounds, 20% nitrate and 19% is unidentified.

* * *

**Partial composition of sugar beet molasses.** J. B. STARK, A. E. GOODBAN and R. M. MCCREADY. *J. Amer. Soc. Sugar Beet Tech.*, 1959, **10**, 651–656.—Nine molasses samples, three from factories using the Steffen process, were diluted to 10–20% dry solids and the certain various non-sucrose constituents (totalling 74% of the total) determined quantitatively. Tabulated details are given of these analyses which cover the basic non-sucrose solids, organic and inorganic acids, the average milli-equivalents for each acid present being listed. On the basis of the data, it is concluded that the only apparent difference between the molasses from the Steffen factories and from the normal factories is in the lower lactate and possibly lower potassium content of the former, although this has yet to be verified. Of the total impurities, the unreported 26% includes sodium raffinose, acetate, galactinol, nitrate and unknown N compounds, together with unidentified compounds comprising up to 20% of the impurities. Chloride shows the greatest quantitative variation, from 1·5 to 8·9 g/100 g non-sucrose solids.

* * *

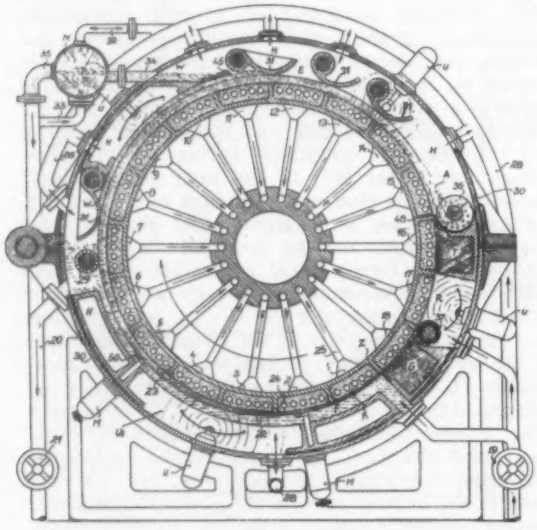
**The behaviour of L-glutamine during sugar production.** S. BÖTTGER and W. STEINMETZER. *Zeitsch. Zuckerind.*, 1960, **85**, 281–290.—The different methods of determining L-glutamine and L- and D-glutamic acid, including the enzymatic method, and L-pyrrolidone carboxylic acid are described with 42 references to the literature. The properties of the various systems (glutamic acid/pyrrolidone carboxylic acid, glutamine/pyrrolidone carboxylic acid, glutamine/glutamic acid/albumin and other condensation products, and glutamine/α-aminobutyric acid) are also discussed, as well as the racemisation of glutamine, glutamic acid and pyrrolidone carboxylic acid. During the 1959/1960 campaign a study was made of the behaviour of L-glutamine in 2 beet factories. No L-glutamic acid was found in the beet brei, which had a glutamine content of 0·209% and a total glutamic acid value of 0·262%, i.e. an L-glutamine content of 80% of the total glutamic acid value of the beet, the remaining 20% probably consisting of albumin substances. Cyclization of the L-glutamine to pyrrolidone carboxylic acid occurs during juice extraction, accompanied by formation of 5% on total glutamic acid value of L-glutamic acid. The cyclization is strongly affected by diffusion time and temperature, but not pH. Cyclization continues during liming, after which only about 60% of the total glutamic acid value remains as glutamine, although only about 5% (of total glutamic acid values) more glutamic acid has been formed; i.e. the principal change in the system during liming is the cyclization rather than hydrolysis to glutamic acid. The L-glutamine content of first carbonatation juice was 46% (on total glutamic acid value), the majority of the glutamic acid values in the mud consisting probably of albumin compounds. Total glutamic acid values in thin juice are reduced to 0·17%, the proportion of glutamine being 31%. Further cyclization reduces this to 12·8% in thick juice and 11·9% in *A*-massecuite, L-glutamic acid being converted at the same time and reducing from 11·8% in thin juice to 7·4% in *A*-massecuite. Further cyclization occurs in the low-product boiling, so that in final molasses all but 6% of the L-glutamine has been cyclised and only about 0·5% of the total glutamic acid values is present as L-glutamic acid.

* * *

**A table of coefficients for obtaining percent sucrose and for simplifying calculations in sucrose analyses.** T. R. ANCHETA. *Proc. 6th Conv. Philippines Sugar Tech.*, 1958, 232–244.—See *I.S.J.*, 1959, **61**, 250.

## UNITED KINGDOM

**Pressure filter.** H. JUNG, of Siegen, Westphalia, Germany. **841,573.** 10th September 1956; 20th July 1960.—In the continuously or periodically-rotating filter illustrated, suitable *inter alia* for the sugar industry, the drum Z has a permeable surface, e.g. of ceramic material, the interior of which is divided into a number of segments—18 as shown. These are provided with axial pipes 24 feeding into the radial pipes 25 which lead into the control head at the end of the filter. Turbid liquid is introduced through valve 19 and enters the filtering chamber *F*. Clear liquid 22 passes through into the pipes 24, 25 corresponding to segments 1–7 while a cake 23 builds up on the filter surface. The structure of this cake is maintained open and permeable by means of the ultrasonic generator U operating in chamber $U_1$. The rate of build-up of cake is determined by the thermo-electric sensing devices *M* located, e.g. at segments 2 and 5, and these may be used to govern the speed of rotation of the filter. Excess turbid liquor overflows through pipe 20. The cake passes



a rotating milling device 29 which levels and opens it so that it can be washed satisfactorily in the next stage (segments 8–11). Wash water is supplied from the constant level chamber *N* and forms a continuous layer *W* over cake 23. The rate of addition of wash water may be controlled from a continuous detection of the concentration of the wash liquor after passing through the cake and into the pipes 24, 25 of segments 8–11; these are separately collected and cycled. Washing is again assisted by an ultrasonic device U. Compressed air dries the cake as it passed over segments 12–14, the surface being smoothed by the curved surfaces 31 which seal up cracks forming which prevent efficient drying. Another ultrasonic generator U is provided at this stage. A reversal of air flow occurs at segment 15 where an air pressure higher than the inward air pressure causes the cake to be driven off the surface; it falls into the screw conveyor 36 and is removed from the filter. Assistance is provided by the scraper 48. The filter surface is prepared for further use at segment 17 where it is brushed by brush 37 and subjected to pulsating backwashing through the corresponding pipe 24, as well as to the ultrasonic vibrations produced by generator U. Alternatively, where a precoat is used it may be applied at this stage.

* * *

**Purification of sugar juices.** ROHM & HAAS CO., of Philadelphia, Pa., U.S.A. **841,620.** 24th August 1956; 20th July, 1960.—Sugar juice (diluted molasses partially demineralized by treatment with anion- and cation-exchange resins) is treated at room temperature with an anion-exchange resin in hydroxide form whereby the salts present are transformed into hydroxides; it is then treated with a metallic salt (of iron or manganese) to yield an insoluble metal hydroxide with resulting coagulation of organic non-sugars. These insolubles are removed and the resultant juice treated with an anion-exchange and a cation-exchange resin either in sequence or a mixed bed.

* * *

**Continuous purification of milk-of-lime for use in sugar mills.** LICENCIA TALÁLMÁNYOKAT ERTÉKESITÖ VÁLLALAT, of Budapest 5, Hungary. **841,756.** 8th December 1958; 20th July 1960.—Impure milk-of-lime from the slaker is led to a settling tank having a sloping bottom fitted with a worm conveyor for removing settled solids. The overflow is sent to a receiving tank and thence to a hydrocyclone which produces a pure milk-of-lime for the process, the sludge being returned to the settling tank.

* * *

**Loading gate for centrifugals.** THE WESTERN STATES MACHINE CO., of Hamilton, Ohio, U.S.A. **841,853.** 28th August 1956; 20th July 1960.—See U.S.P. 2,789,730.[1]

[1] *I.S.J.*, 1958, **60**, 82.

Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 3s. 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

**Beet thinner.** LANDBOUWWERKTUIGEN EN MACHINEFABRIEK H. VISSERS N.V., of Nieuw Vennep, Holland. **842,346.** 17th March 1959; 27th July 1960.

* * *

**Centrifugal battery control system.** THE WESTERN STATES MACHINE CO., of Hamilton, Ohio, U.S.A. **842,357.** 28th August 1956; 27th July 1960.—See U.S.P. 2,790,553.[1]

* * *

**Beet harvesters.** (1) F. A. STANDEN & SONS LTD., and P. STANDEN, of St. Ives, Hunts. **842,422; 842,423.** 8th August 1958; 27th July 1960. (2) OVERUMS BRUK, of Overum, Sweden. **842,572.** 14th June 1957; 27th July 1960. (3) BUCHER-GUYER A.G., of Zürich, Switzerland. **842,849.** 26th March 1959; 27th July 1960.

* * *

**Centrifugals.** SOC. DES RAFFINERIES ET SUCRERIES SAY, of Paris 7e, France. **843,020.** 18th July 1957; 4th August 1960.—In addition to the electric motor attached to the shaft of a centrifugal, an auxiliary drive is provided, e.g. in the form of a hydraulic device coupled to the shaft, in such a way that it can be connected or disconnected at will. The inlet and outlet conduits of the device are connected to, respectively, a tank and an accumulator. When the centrifugal is being accelerated the coupling is connected and the passage of fluid from the accumulator to the tank transfers energy to the shaft, so helping to accelerate it. When the normal running speed is reached the coupling is disconnected and the basket rotates under the action of the electric motor alone. When spinning is finished the coupling is re-connected and the hydraulic device's distributor arranged so that it acts as a pump, transferring fluid from the tank to the accumulator and thus absorbing energy from the basket and decelerating it.

* * *

**Ester salts of sugars.** FARBENFABRIKEN BAYER A.G., of Leverkusen-Bayerwerk, Germany. **843,067.** 21st July 1958; 4th August 1960.—A fatty acid ester of a sugar (monoester of sucrose, maltose, lactose or raffinose with lauric, palmitic, stearic or oleic acid) is reacted with a dicarboxylic anhydride (maleic, succinic or phthalic anhydride), the latter in excess or equimolecular proportions, at an elevated temperature, in non-aqueous solvent (dimethylformamide) the salt being formed (during the reaction) by the action of sodium, potassium or ammonium carbonate.

* * *

**Beet harvester.** CATCHPOLE ENGINEERING CO. LTD., of Bury St. Edmunds, Suffolk. **843,600.** 1st April 1959; 4th August 1960.

**Beet thinner.** BRITISH SUGAR CORPORATION LTD., of London W.1. and C. M. BRADFORD, of Holme, Northants. **845,718.** 28th February 1958; 24th August 1960.

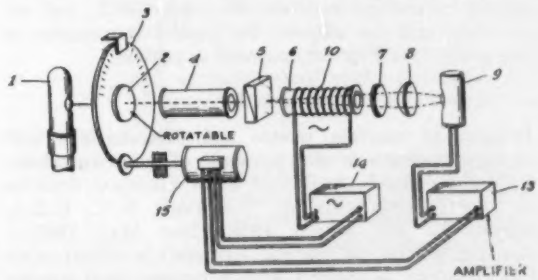
* * *

**Paper making pulp (from bagasse).** HAWAIIAN DEVELOPMENT COMPANY, of Honolulu, Hawaii, U.S.A. and CROWN ZELLERBACH CORPORATION, of San Francisco, Calif., U.S.A., assignees of D. D. HINRICHS, F. L. SCHMIDT and J. D. WETHERN. **846,232.** 13th January 1959; 31st August 1960.—Depithed bagasse is mixed with sodium hydroxide of pH at least 12 [0·1–25% (0·2–3%)] (by being passed continuously through a tank of NaOH at a rate calculated to give the necessary reaction time) to such an extent that the liquor:dry bagasse ratio is 2:1–100:1 (4:1–12:1), the temperature being maintained at 50–250°F (150°F to the boiling point) until the bagasse has consumed 1–7% (3–6%) of its own dry weight of the NaOH, thereby softening it. The softened bagasse is defibred mechanically, passing it once (one to five times) through the machine, to a pulp of 1–3% (4–10%) defibring consistency, at a temperature of 70–220°F (170—212°F), diluted to a consistency of 0·5–3%, screened and bleached [by adding 0·2–5% (0·5–2%) of $Na_2S_2O_4$ (and $ZnS_2O_4$, calculated as $Na_2S_2O_4$), oven dry cellulose basis, of which 5–95% (40–60%) by weight may be added at the softening stage and the remainder after defibring]. The mechanical-type pulp may be mixed with 1–50% by weight, dry basis, of chemical paper-making pulp, and processed into paper.

* * *

## UNITED STATES

**Photo-electric polarimeter.** H. WENKING, assr. CARL ZEISS, Württemberg, Germany. **2,933,972.** 26th January 1956; 26th April 1960.—The device illustrated includes a monochromatic light source 1, a polarizer 2, the measured object 4, an optical element 5 for separating the incident beam into two divergent polarized light beams polarized at right angles to




each other, an analyzing system 6, 7, a lens for recombining the divergent light beams and a photocell 9. A magneto-optically active substance 6, e.g. water is combined with the stationary analyzer 7, and is subjected to the action of the magnetic field

[1] *I.S.J.*, 1958, **60**, 347.

created by the alternating current passed through coil 10. The polarizer 2 is rotated until compensation is reached and the polarization may be read on scale 3. The photocell current may be amplified and fed into a phase-depending electric motor 15. The A.C. produced by generator 14 and fed to the coil 10 is also fed into motor 15, the two combining to cause the motor to rotate the polarizer 2 automatically so as to minimize the a.c. component of the photo-electric current. By replacement of the polarizer 2 by a stationary polarizer and a second magneto-optical element the polarization of the substance under test may be measured in terms of the current necessary for balancing with the second magneto-optical element, again automatically if desired. Alternatively, instead of a current-reading device, the polarization may be read by means of a digital indicator connected to the second element.

* * *

**Bulk sugar silo.** N. R. M. WEIBULL, assrs. INGENIORS-FIRMAN NILS WEIBULL A.B, of Malmö, Sweden. **2,935,263.** 13th February 1956; 3rd May 1960.—See U.K.P. 799,413.[1]

* * *

**Centrifugal driving and suspension means.** J. HERTRICH, assr. THE WESTERN STATES MACHINE CO., of Hamilton, Ohio, U.S.A. **2,936,894.** 6th April 1954; 17th May 1960.—See U.K.P. 784,949.[2]

* * *

**Extraction of sugar-containing materials (beet or cane) that have been treated with a cell-killing agent.** H. I. WATERMAN, assr. N. V. CENTRALE SUIKER MIJ., Fabriek "Wittouck", Breda, Netherlands. **2,937,958.** 4th August 1958; 24th May 1960.—The sugar-containing material is first exposed for up to 10 sec (5 sec) to 0·02–0·05% by weight of $SO_2$, which is rapidly absorbed; it is then exposed to the action of $CHCl_3$ (in an atmosphere at least approximately saturated with $CHCl_3$ vapour) at a temperature of 35–45°C (40°C), after which it is subjected to diffusion at room temperature - 50°C. The material is agitated during its contact with the $SO_2$ and $CHCl_3$ and absorption may be effected by partial evacuation of the space in which the material is present.

* * *

**Process of reacting mono- and disaccharides with various reagents in the presence of γ-butyrolactone.** J. WERNER and F. A. HESSEL, assrs. GENERAL ANILINE & FILM CORPORATION, of New York, N.Y., U.S.A. **2,938,898.** 4th March 1958; 31st May 1960.—Sucrose, glucose or fructose (sucrose) in γ-butyrolactone solution is treated with a reagent also soluble in this solvent (palmitoyl chloride, acetic anhydride, sulphuryl chloride, 1,4-dichloro-2-butyne). Glucose is similarly reacted with maleic anhydride, while the use of the lactone as a solvent for other esterifying and replacement reactions with sucrose is also mentioned.

**Beet harvester.** O. E. KROLL, of Sacramento, Calif., U.S.A. **2,940,529.** 24th July 1958; 14th June 1960.

* * *

**Sugar manufacture by alcohol extraction.** V. E. HAURY, assr. SIMCO INC., of San Francisco, Calif., U.S.A. **2,943,004.** 31st March 1958; 28th June 1960.—Sugar source material (beets, cane) is dehydrated to a moisture content no greater than 10% by weight, ground and screened, and extracted with 2–10 times its weight of a solvent or mixture of solvents (ethanol or methanol), heating in a closed system to a temperature between 10°C above boiling and 200°C (100–150°C) at a pressure greater than atmospheric. The extraction is carried out in the presence of decolorizing carbon and under slightly alkaline conditions. The alcohol is separated and cooled by releasing the pressure, whereupon the extracted sugar crystallizes. It is filtered off, washed with alcohol and dried, or may be recrystallized from a suitable solvent, while the alcoholic mother-liquor is reused for further extraction.

* * *

**Dialdehyde sugar reaction products, process for preparing same and printing ink prepared therefrom.** R. J. BAIRD, assr. THE NATIONAL SUGAR REFINING CO., of New York, N.Y., U.S.A. **2,944,034.** 4th January 1956; 5th July 1960.—An aliphatic dialdehyde (glutaraldehyde, α-hydroxyadipaldehyde, glyoxal), produced in situ by hydrolysis of a pyran precursor (2-ethoxy-4 methyl-3,4-dihydro-1,2-pyran ; 2,3-dihydro-2-ethoxy-1,4-pyran ; 2,3-dihydro-2-ethoxy-4-methyl pyran) is condensed (under pressure) with a sugar (e.g. sucrose) having at least two pairs of hydroxyl groups each pair having its hydroxyls separated by less than 4 carbon atoms, in such a ratio that there are at least 3–16 moles of hydroxyl groups per mole of aldehyde, in a reaction medium (water, dioxan, tetrahydrofuran, diethylene glycol) of a pH below 7, at a temperature between 50°C and that at which decomposition of either reactant occurs, during sufficient time to permit condensation by elimination of water; this water and any water added as reaction medium is removed giving a solvent-soluble condensation product. A condensation catalyst may be present to the extent of one tenth of the total molecular proportions of the reactants. The reaction product (glyoxal-sucrose resin) in a proportion of 35–45% (40%) is mixed with a printing ink pigment (carbon black) in a proportion of 15–20%, 35–50% (40–45%) of a solvent for the resin (propylene glycol), and an acid catalyst (boron fluoride etherate) to the extent of 6–9% (7½%) of the resin, to give printing ink.

* * *

**Beet harvester and cleaner.** E. C. ROLLINS, of Ogden, Utah, U.S.A. **2,944,611.** 7th April 1958; 12th July 1960.

[1] *I.S.J.*, 1958, **60**, 341.
[2] *I.S.J.*, 1958, **60**, 85.

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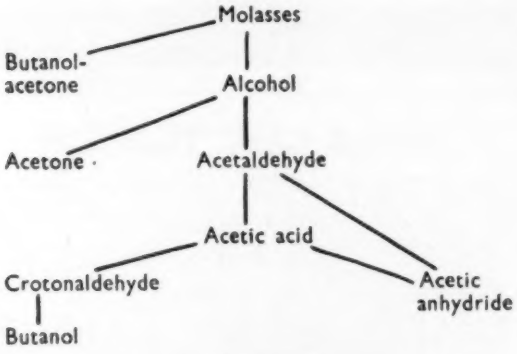


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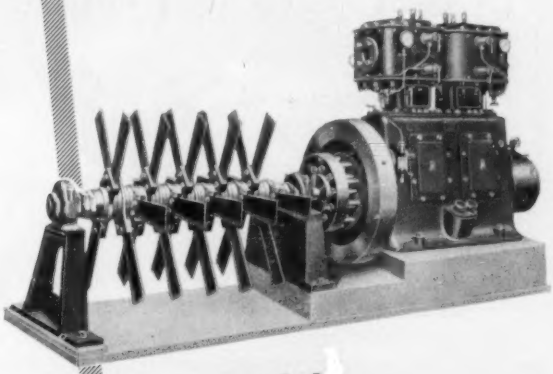

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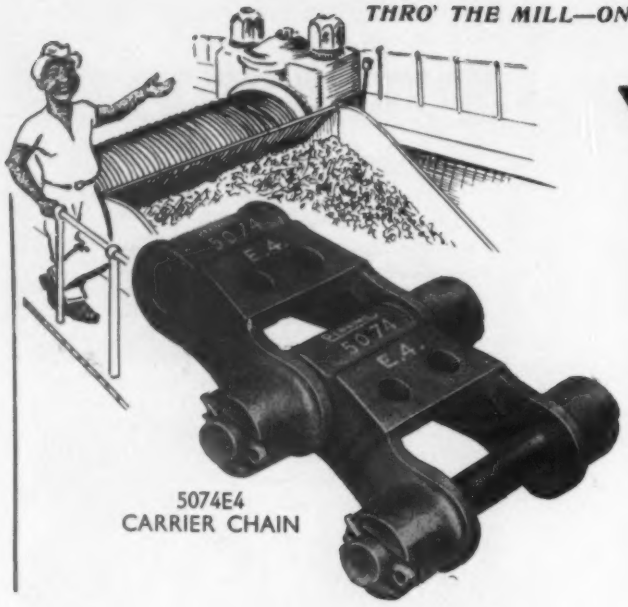


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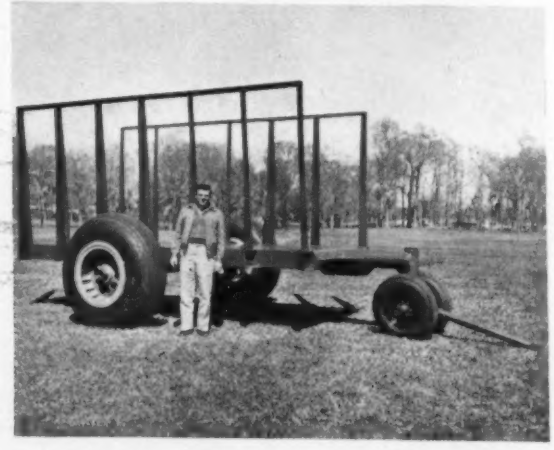

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# TRADE NOTICES

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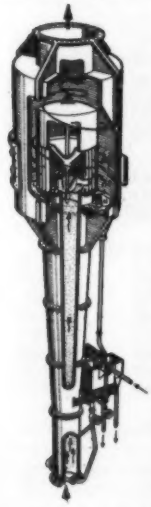
---

**The "Airmix" wet dust collector.** Thermix Industries Ltd., Surbiton, Surrey.

This new equipment has a variety of uses in applications involving industrial dust collection and is easily adapted for installation as a secondary collector on existing plants where increased efficiency is desired.

It is a self-induced spray-type vertical venturi wet washer which separates the dirty water from the cleaned gases by means of centrifugal action. The washing water is fed tangentially to the venturi throat by two, three or four pipes depending on the size of the collector. The gases flowing through the throat at high speed spread the water on to the cylindical surface in a continuous film and at the same time carry it vertically. The great difference in the velocity of the two fluids causes the gas to break up the waves which form on the surface of the water film thus intimately mixing the dust-laden gas and the water droplets in the fine spray produced.



The mixture then enters a tapered diffuser section where its speed is slowed down and the dust particles which have so far escaped are wetted as the dust-laden gas again passes through a cloud of water droplets which, owing to their tendency to agglomerate, have a slower upward movement.

Upon reaching the top section of the "Airmix" the mixture is diverted into a ring of curved vanes which impart a strong rotational motion which separates the gases and water by centrifugal action. Any particles still in a dry state are wetted by impingement with the vanes. The dirty water is evacuated by a discharge pipe and the cleaned gases pass out through a chimney.

The unit is constructed of mild steel and is available in a range of standard sizes with capacities from 1,300 c.f.m. to 30,000 c.f.m.

* * *

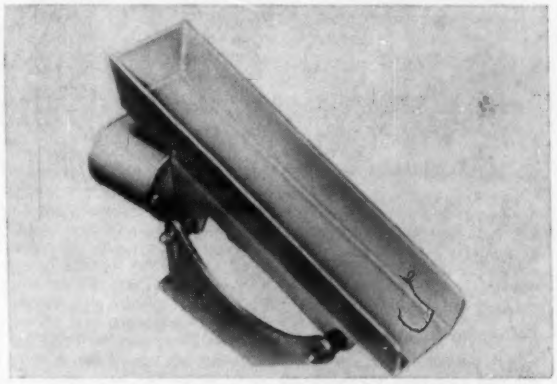
**"Flexpanda" tube cleaners.** Rotatools (U.K.) Ltd., Pembroke Works, 43/45 Pembroke Place, Liverpool 3.

A factory was having trouble with small diameter copper evaporator tubes of between 26 and 30 mm bore, lined with scale about 1/32nd inch thick. The tubes, 16 ft long were unsupported in the middle and all attempts at mechanical cleaning had been unsuccessful because the tools used damaged the tubes and caused them to bow. They were cleaned with a new type of tool, the "Flexpanda," in which the brush or hardened blades are in the form of inserts fitting into slots in the tool head with springs located underneath to force them outward from the body. They are held in a position by lugs which fit under the lips of the end plate of the body and the removable rear end cap. The tools are available for bores ranging from 0·792 inches to 2 $\frac{5}{16}$ inches, a range which includes all evaporator and juice heater tube sizes. The manufacturers offer free advice on difficult tube cleaning problems.

* * *

**Magnetic vibrator feeder.** Magco Ltd., Lake Works, Porchester, Hants.

A new design of magnetic vibrating conveyor feeder with an output variable between 1 pound and 10 tons per hour has the magnet attached to the tray which is of cast aluminium and can be adjusted



over an angle of 10°. The stands are for base or overhead fixing, and are also of cast aluminium, giving a combination of light weight and rigidity. The tray can be provided with special linings where required, and an advantage is that no lubrication is needed.

* * *

### PUBLICATIONS RECEIVED

**"SKATOSKALO."** Flexible Drives (Gilmans) Ltd., Skatoskalo Works, Millers Rd., Warwick.

"Skatoskalo" tube cleaning equipment is described as suitable for almost any tubular or drum installation and for every tube and surface scaling problem in a new booklet, 60/1, which provides illustrations and specifications of the light-, standard- and heavy-duty scaling sets, multi-speed and multi-drive sets, air motors, flexible drives, handpieces and spares, scaling heads, brushes, pneumatic piston-type hammers, and all the other Flexible Drives (Gilmans) Ltd. equipment for scale removal. A number of photographs show the equipment in action, some in sugar factories.

# SUGAR CROPS OF THE WORLD

WILLETT & GRAY'S CROP ESTIMATES*

(1) CANE SUGAR

| | Harvesting Period | Long Tons | | Short Tons | | Metric Tons | |
|---|---|---|---|---|---|---|---|
| | | 1959/60 | 1958/59 | 1959/60 | 1958/59 | 1959/60 | 1958/59 |
| United States—Louisiana | Oct.–Jan. | 393,214 | 395,351 | 440,400 | 442,793 | 399,525 | 401,696 |
| Florida | Oct.–Apr. | 150,000 | 120,500 | 168,000 | 134,960 | 152,408 | 122,434 |
| Puerto Rico | Jan.–June | 898,600 | 963,732 | 1,006,432 | 1,079,380 | 913,023 | 979,200 |
| Hawaiian Islands | Jan.–Dec. | 860,000 | 870,207 | 963,200 | 974,632 | 873,803 | 884,175 |
| Virgin Islands | Jan.–June | 6,000 | 10,800 | 6,720 | 12,096 | 6,096 | 10,973 |
| Cuba | Jan.–June | 5,765,000 | 5,369,188 | 6,456,800 | 6,573,491 | 5,857,528 | 5,963,388 |
| British West Indies— | | | | | | | |
| Trinidad | Jan.–June | 187,500 | 181,131 | 210,000 | 202,867 | 190,509 | 184,038 |
| Barbados | Jan.–June | 153,000 | 184,152 | 171,360 | 206,250 | 155,456 | 187,108 |
| Jamaica | Jan.–June | 423,180 | 376,042 | 473,962 | 421,167 | 429,972 | 382,077 |
| Antigua | Jan.–June | 20,000 | 28,695 | 22,400 | 32,138 | 20,321 | 29,156 |
| St. Kitts | Feb.–Aug. | 48,000 | 46,441 | 53,760 | 52,014 | 48,770 | 47,186 |
| Other B.W.I. | Jan.–June | 9,600 | 11,053 | 10,752 | 12,379 | 9,754 | 11,230 |
| French West Indies— | | | | | | | |
| Martinique | Jan.–July | 97,000 | 75,571 | 108,640 | 84,640 | 98,557 | 76,784 |
| Guadeloupe | Jan.–July | 127,000 | 139,414 | 142,240 | 156,144 | 129,038 | 141,652 |
| Dominican Republic | Jan.–July | 902,704 | 890,954 | 1,011,028 | 997,868 | 917,192 | 905,254 |
| Haiti | Dec.–June | 50,000 | 49,000 | 56,000 | 54,880 | 50,803 | 49,786 |
| Mexico | Nov.–Oct. | 1,475,000 | 1,300,000 | 1,652,000 | 1,456,000 | 1,498,674 | 1,320,865 |
| Central America— | | | | | | | |
| Guatemala | Jan.–June | 67,500 | 65,000 | 75,600 | 72,800 | 68,583 | 66,043 |
| Salvador | Nov.–March | 50,000 | 44,500 | 56,000 | 49,840 | 50,803 | 45,214 |
| Other N. & Cent. America | Jan.–June | 190,000 | 170,000 | 212,800 | 190,400 | 193,050 | 172,729 |
| South America— | | | | | | | |
| British Guiana | Oct.–June | 330,000 | 284,425 | 369,600 | 318,556 | 335,297 | 288,990 |
| Colombia | Oct.–June | 265,000 | 245,982 | 296,800 | 275,500 | 269,253 | 249,930 |
| Venezuela | Oct.–June | 180,000 | 165,000 | 201,600 | 184,800 | 182,889 | 167,648 |
| Ecuador | June–Jan. | 94,000 | 99,500 | 105,280 | 111,440 | 95,508 | 101,097 |
| Peru | Jan.–Dec. | 750,000 | 735,000 | 840,000 | 823,200 | 762,038 | 746,797 |
| Argentina | May–Oct. | 900,000 | 876,992 | 1,008,000 | 982,231 | 914,445 | 891,068 |
| Brazil | June–May | 3,140,000 | 3,310,000 | 3,516,800 | 3,707,200 | 3,190,397 | 3,363,126 |
| Other South America | Jan.–Dec. | 125,000 | 140,000 | 140,000 | 156,800 | 127,006 | 142,247 |
| Total Americas | | 17,657,298 | 17,648,630 | 19,776,174 | 19,766,466 | 17,940,698 | 17,931,891 |
| India and Pakistan (Gur) | Dec.–May | 3,650,000 | 3,900,000 | 4,088,000 | 4,368,000 | 3,708,582 | 3,962,596 |
| do. (White) | Oct–July | 2,215,000 | 1,919,000 | 2,480,800 | 2,149,280 | 2,250,551 | 1,949,800 |
| Indonesia | May–Nov. | 850,000 | 841,943 | 952,000 | 942,976 | 863,643 | 855,456 |
| Japan | Oct.–March | 137,292 | 118,885 | 153,767 | 133,151 | 139,496 | 120,793 |
| Taiwan (Formosa) | Oct.–May | 865,000 | 920,950 | 968,800 | 1,031,464 | 878,883 | 935,731 |
| Philippine Islands | Sept.–Aug. | 1,378,500 | 1,350,367 | 1,543,920 | 1,512,411 | 1,400,625 | 1,372,040 |
| Other countries | | 1,066,000 | 1,025,000 | 1,193,920 | 1,148,000 | 1,083,109 | 1,041,451 |
| Total Asia | | 10,161,792 | 10,076,145 | 11,381,207 | 11,285,282 | 10,324,889 | 10,237,867 |
| Australia | June–Nov. | 1,288,477 | 1,412,273 | 1,443,094 | 1,581,746 | 1,309,157 | 1,434,940 |
| Fiji Islands | June–Nov. | 280,000 | 202,236 | 313,600 | 226,504 | 284,494 | 205,482 |
| Total Australia and Polynesia | | 1,568,477 | 1,614,509 | 1,756,694 | 1,808,250 | 1,593,651 | 1,640,422 |
| Egypt | Jan.–June | 315,000 | 325,000 | 352,800 | 364,000 | 320,056 | 330,216 |
| Mauritius | June–Jan. | 579,841 | 517,391 | 649,422 | 579,478 | 589,147 | 525,695 |
| Réunion | Aug.–Jan. | 215,000 | 205,000 | 240,800 | 229,600 | 218,450 | 208,290 |
| Natal and Zululand | May–April | 931,519 | 1,128,187 | 1,043,301 | 1,263,569 | 946,470 | 1,146,294 |
| Mozambique | May–Dec. | 140,000 | 150,767 | 156,800 | 168,859 | 142,247 | 153,187 |
| Angola | May–Oct. | 56,000 | 49,511 | 62,720 | 55,452 | 56,899 | 50,306 |
| British East Africa† | Sept.–Aug. | 140,000 | 130,000 | 156,800 | 145,600 | 142,247 | 132,087 |
| Other Africa | | 175,000 | 160,000 | 196,000 | 179,200 | 177,809 | 162,568 |
| Total Africa | | 2,552,360 | 2,665,856 | 2,858,643 | 2,985,758 | 2,593,325 | 2,708,643 |
| **Total Cane Sugar Crops** | | **31,939,927** | **32,005,140** | **35,845,718** | **35,772,756** | **32,452,563** | **32,518,823** |

*Dated: 25th August 1960.

# SUGAR CROPS OF THE WORLD

*(continued)*

(2) BEET SUGAR

| | Harvesting Period | Long Tons | | Short Tons | | Metric Tons | |
|---|---|---|---|---|---|---|---|
| | | 1959/60 | 1958/59 | 1959/60 | 1958/59 | 1959/60 | 1958/59 |
| Europe—Germany | Sept.–Jan. | 2,035,000 | 2,815,000 | 2,279,200 | 3,152,800 | 2,067,662 | 2,860,180 |
| Czechoslovakia | Sept.–Jan. | 715,000 | 930,000 | 800,800 | 1,041,600 | 726,475 | 944,927 |
| Hungary | Sept.–Jan. | 385,000 | 293,000 | 431,200 | 328,160 | 391,179 | 297,702 |
| France | Sept.–Jan. | 1,060,000 | 1,575,000 | 1,187,200 | 1,764,000 | 1,077,013 | 1,600,279 |
| Belgium | Sept.–Jan. | 215,000 | 455,000 | 240,800 | 509,600 | 218,450 | 462,302 |
| Holland | Sept.–Jan. | 500,000 | 570,000 | 560,000 | 638,400 | 508,025 | 579,149 |
| Russia and Ukraine | Sept.–Jan. | 6,000,000 | 6,235,000 | 6,720,000 | 6,983,200 | 6,096,300 | 6,335,072 |
| Poland | Sept.–Jan. | 975,000 | 1,200,000 | 1,092,000 | 1,344,000 | 990,649 | 1,219,260 |
| Sweden | Sept.–Dec. | 280,000 | 263,000 | 313,600 | 294,560 | 284,494 | 267,221 |
| Denmark | Sept.–Jan. | 245,000 | 395,000 | 274,400 | 442,400 | 248,932 | 401,340 |
| Italy | Aug.–Oct. | 1,420,000 | 1,122,000 | 1,590,400 | 1,256,640 | 1,442,791 | 1,140,008 |
| Spain | July–Feb. | 498,875 | 428,716 | 558,740 | 480,162 | 506,882 | 435,597 |
| Switzerland | Sept.–Jan. | 42,000 | 37,000 | 47,040 | 41,440 | 42,674 | 37,594 |
| Bulgaria | Sept.–Jan. | 160,000 | 125,000 | 179,200 | 140,000 | 162,568 | 127,006 |
| Roumania | Sept.–Jan. | 275,000 | 183,000 | 308,000 | 204,960 | 279,414 | 185,937 |
| Great Britain† | Sept.–Jan. | 760,000 | 723,000 | 851,200 | 809,760 | 772,198 | 734,604 |
| Eire† | Sept.–Jan. | 130,000 | 110,000 | 145,600 | 123,200 | 132,087 | 111,765 |
| Jugoslavia | Sept.–Jan. | 250,000 | 190,000 | 280,000 | 212,800 | 254,013 | 193,050 |
| Turkey† | Sept.–Jan. | 500,000 | 360,000 | 560,000 | 403,200 | 508,025 | 365,778 |
| Other Europe | Sept.–Jan. | 350,000 | 335,000 | 392,000 | 375,200 | 355,618 | 340,377 |
| United States—Beet† | July–Jan. | 1,920,000 | 1,849,043 | 2,150,400 | 2,070,928 | 1,950,816 | 1,878,720 |
| Canada—Beet† | Oct.–Dec. | 126,000 | 151,913 | 141,120 | 170,143 | 128,022 | 154,351 |
| Other countries | | 420,000 | 420,000 | 470,400 | 470,400 | 426,741 | 426,741 |
| **Total Beet Sugar Crops** | | **19,261,875** | **20,765,672** | **21,573,300** | **23,257,553** | **19,571,028** | **21,098,961** |
| **Grand Total—Cane and Beet** | | **51,201,802** | **52,770,812** | **57,346,018** | **59,103,309** | **52,023,591** | **53,617,784** |

† Refined.

# BREVITIES

**U.S. Aid Funds and the exclusion of Cuban sugar purchases.** The International Cooperation Administration, which handles the United States foreign aid funds under the Mutual Security Act, is reported in the Press to have confirmed that it had amended a purchase grant to Morocco providing for the purchase of ten million dollars' worth of sugar to prevent the purchase from Cuba. The I.C.A. said that the action was not a policy switch but was taken in this instance "because of difficulty of doing business with Cuba." If Morocco is able to arrange the purchase of other food imports with the I.C.A. funds, she may be able to use her own unused foreign currency to buy the required sugar—from Cuba if she so wishes.

* * *

**Argentina and the International Sugar Agreement.**[1]—It has recently been rumoured that Argentina has applied to join the International Sugar Agreement. Such a step would open a number of outlets for her sugar and would be in conformity with the recent action taken by the Argentina Government designed at disposing of the heavy stocks at present existing in the country. Under the terms of the Agreement the United States is prevented from importing more than an insignificant tonnage from non-members and this might well presage the granting of a non-quota entitlement to Argentina.

* * *

**British Honduras factory proposals.**[2]—The Government of British Honduras has invited applications for a licence to operate a factory for the production of sugar for both local and foreign consumption. The successful applicant will be required to produce an annual minimum of 12,500 long tons for export in addition to supplying half the requirements for local consumption, which total about 2000 tons a year. Various tax concessions will run for eleven years from the date of the award of the licence.

**Argentine Sugar Bill.**[3]—Drastic steps have been decided upon by the Argentine Government in an effort to dispose of the excessive stocks of sugar which are being carried in that Country. Argentina is a high cost producer and the difficulty hitherto has been in relating the cost of production to prevailing world market values. Under the terms of the new provisions, sugar at present in stock together with any production during 1960 and 1961 in excess of domestic requirements and essential reserves is liable to expropriation with all mills sharing *pro rata* to their production. So far as this year is concerned the exportable surplus stocks at present in existence and estimated to be forthcoming from the current campaign is put at 220,000 tons. Any sugar taken over in this manner would be exported; the price paid to mills would be the world market value at the time of the court order. The Government has been given authority to fix the price of cane for the 1959 crop, whilst for the 1960 harvest mills are required to pay growers on delivery at least 360 pesos per metric ton for cane with a sugar content of not less than 6·27%. In the case of sugar having a lower sucrose value a subsidy will be paid to the mills but in order to improve the quality of the cane grown the minimum at which this will be forthcoming has been left to the discretion of the Government. This season it has been set at 5%, below which the cane price will depend upon the actual sucrose content. So that harvesting of the present crop shall not be hindered by lack of currency the Government is empowered to provide credit facilities to the industry. In order to finance these measures an emergency tax of up to 2·50 pesos per kilo is to be imposed on all sugar in stock, whether at mills or held by the trade. The provisions of the Bill are to remain in force until the conclusion of the 1961 harvest and the consequent trade cycle.

[1] F. O. Licht, *International Sugar Report*, 1960, **92**, (Supp. 17), 209.

[2] *Overseas Review* (Barclays D.C.O.), September 1960, p.30.

[3] Leng Roberts & Co. (London) Ltd., through C. Czarnikow Ltd., *Sugar Review*, 1960, (471), 147–8.

# BREVITIES

**Sugar factory for Guatemala.**[1]—An agricultural group in Guatemala is planning to set up a cooperative sugar mill with a capacity to produce some 98,000 tons of sugar which, it is hoped, will establish that country's status as an exporter. At present under the International Sugar Agreement, Guatemala is permitted to export to the free market up to 5000 metric tons, raw value, but this appears never to be filled and production just manages to keep ahead of local consumption.

* * *

**Record sugar production in India.**[2]—The final estimates in respect of the 1959/60 sugar harvest, compared with the final figures of the previous season in brackets, are: cane area 5,178,000 acres (4,836,000 acres); cane production 75,038,000 tons (70,915,000 tons), and sugar production in terms of gur 7,579,000 tons (7,158,000 tons). The increase in production is due to favourable weather during the growing season as well as to expanded acreage.

* * *

**Mauritius sugar crop reduction.**—Estimates of a 40–50% reduction in the sugar crop from Mauritius have been quoted in the press but an accurate forecast depended on actual milling results. It is now reported[3] that the first factory started crushing on the 29th June and it was expected that all the 23 factories would be in operation by the middle of August. First results obtained indicated a reduction of about 60% in the fields and a reduction of about 2% in the sucrose content as compared with first results last year.

## Stock Exchange Quotations

**London Stocks** (*at 19th September*, 1960)

| | CLOSING MIDDLE |
|---|---|
| Anglo-Ceylon (5s) | 15/3 |
| Antigua Sugar Factory (£1) | 15/3 |
| Booker Bros. (10s) | 31/9 |
| British Sugar Corp. Ltd. (£1) | 25/6 |
| Caroni Ord. (2s) | 4/– |
| Caroni 6% Cum. Pref. (£1) | 17/– |
| Distillers Co. Ltd. (10s units) | 42/6 |
| Gledhow Chaka's Kraal (£1) | 42/6 |
| Hulett & Sons (£1) | 52/6 |
| Jamaica Sugar Estates Ltd. (5s units) | 4/1½ |
| Leach's Argentine (10s units) | 25/– |
| Reynolds Bros. (£1) | 34/8½ |
| St. Kitts (London) Ltd. (£1) | 19/4½ |
| Ste. Madeleine (Ord.) (£1) | 31/9 |
| Sena Sugar Estates Ltd. (10s) | 14/9 |
| Tate & Lyle Ltd. (£1) | 58/3 |
| Tate & Lyle Investments Ltd. (5s) | 11/3 |
| Trinidad Sugar (5s stock units) | 34/3 |
| United Molasses (10s stock units) | 37/6 |
| West Indies Sugar Co. Ltd. (£1) | 19/4½ |

**New York Stocks** (*at 17th September*, 1960)

| | CLOSING MIDDLE $ |
|---|---|
| American Crystal ($10) | 39 |
| Amer. Sugar Ref. Co. ($100) | 27½ |
| Central Aguirre ($5) | 22⅛ |
| Cuban American ($10) | 14½ |
| Great Western Sugar Co. | 29¼ |
| South P.R. Sugar Co. | 14½ |
| United Fruit Co. | 19 |

**Bookers acquisition in Jamaica.**—Booker Brother, McConnell & Co. Ltd. announced early in August that they have purchased a majority interest in the equity capital of Innswood Estate Ltd. in Jamaica. Innswood's estimated production of sugar in the current crop is 18,000 tons.

* * *

**Corrigendum.** In the second sentence of our abstract of the paper "Formation of conglomerates of sugar crystals" by M. KAMODA and T. YAMANE[4], the word "decrease" should read "increase", i.e. "The number of conglomerates increased with *increase* in the supersaturation of the syrup. . . ."

* * *

**Colombia and the International Sugar Agreement.**[5]—The Government of Colombia will shortly begin negotiations for Colombian participation in the International Sugar Agreement. Colombia has a surplus estimated at 30,000 tons for 1960 and this may reach 60,000 tons in 1961. It was stated by the Minister of Development that offers had been made to supply sugar to Venezuela.

* * *

**Triangle Sugar Estate expansion.**[6]—It is anticipated that £3,500,000 will be spent during the next two years by Triangle Ltd. on a new mill capable of handling 75,000 tons of sugar a year, and on clearing and preparing 12,000 acres of land additional to the nearly 6000 acres ot present under cultivation on the Company's sugar estates at Triangle.

* * *

**Building bricks from sugar.**—A £A 200,000 factory erected by a construction company, Westfield Building Co., in Sydney is reported[7] to be for the production of bricks from a mixture of sugar, sand and aluminum phosphate. The bricks are similar in appearance to coral and are in extensive use in the U.S. as well as in Europe where they were developed. The manufacturers claim that building costs may be reduced by more than 20% by using these bricks which weigh only a third of the usual type of brick.

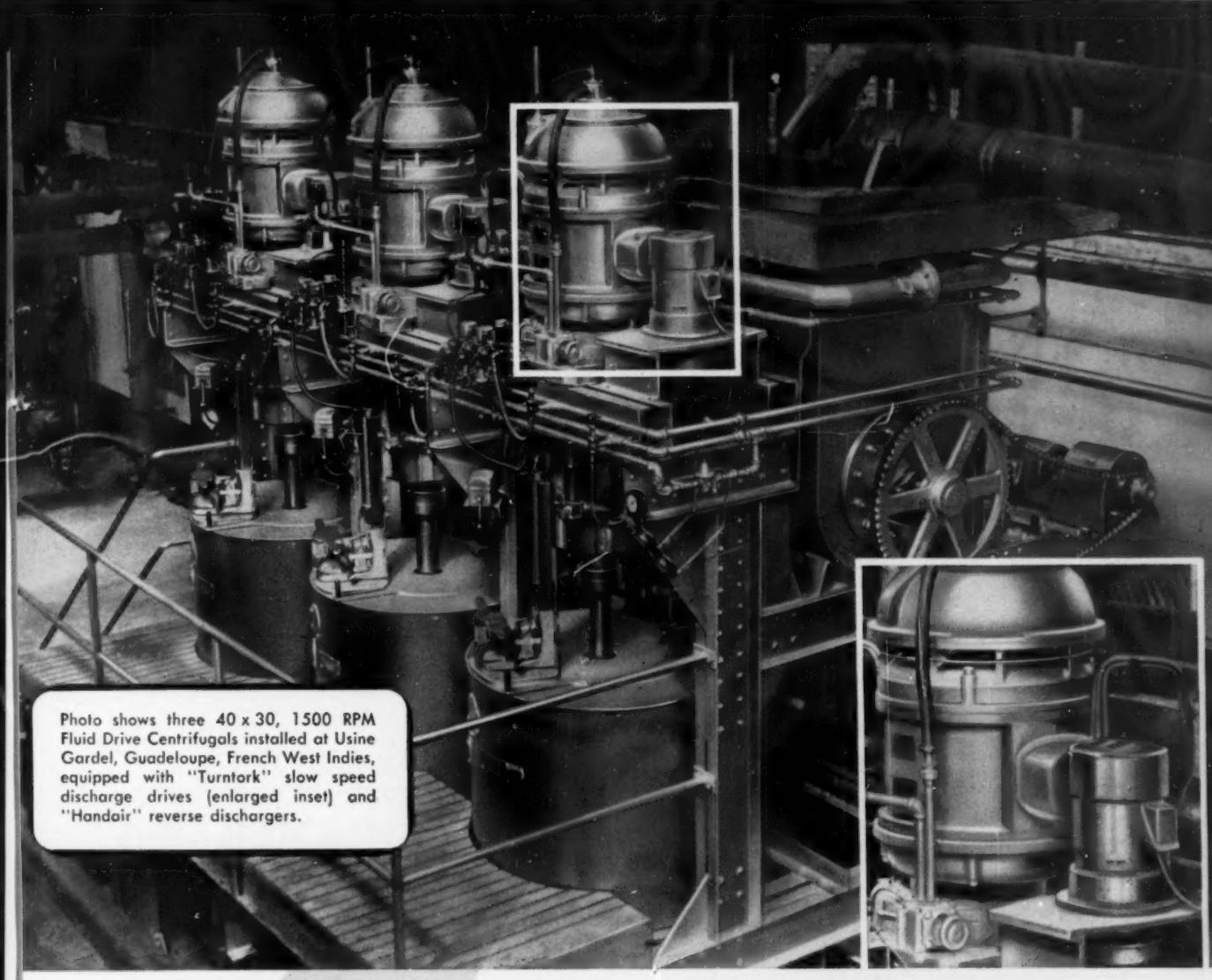
* * *

**New York World Contract under revision.**[8]—It is reported that a Committee has been formed by the New York Coffee & Sugar Exchange Inc. and is now working on revising the current Raw Sugar Contract No. 4. Currently, Cuban, Dominican, Haitian, Peruvian, Brazilian and Mexican sugar are deliverable against the contract and it is felt that the contract will have to be revised to cover deliveries from other primary world suppliers in view of recent quota adjustments. The findings of the Committee will be submitted to the Exchange for approval at a later date.

* * *

**Sugar developments in Guatemala.**[9]—The Sugar Cane Growers' Association has announced the setting up of a technical advisory office to assist growers in all stages of cultivation; the office is also to provide financial aid to assist in the selling of sugar cane. The plan is part of a sugar development campaign aimed at increasing the present annual production of raw sugar of some 64,000 tons which is virtually all sold on the domestic market. The Association has also announced that sugar mills will be able to grind an additional tonnage of cane beginning with the 1960/61 season. In the U.S. sugar allocations announced on the 21st July Guatemala was included as a supplier of the the amount of 6000 tons for the year.

[1] C. Czarnikow Ltd., *Sugar Review*, 1960, (465), 124.
[2] C. Czarnikow Ltd., *Sugar Review*, 1960, (467), 132.
[3] *Overseas Review* (Barclays D.C.O.), August 1960, 21.
[4] *I.S.J.*, 1960, **62**, 228.
[5] *Fortnightly Review* (Bank of London & South America Ltd.), 1960, **25**, 1195, 1196.
[6] *Overseas Review* (Barclays D.C.O.), September 1960, p.28.
[7] *Zuckererzeugung*, 1960, **8**, 230; *Australian Sugar J.*, 1960, **52**, 413.
[8] *Public Ledger*, 20th August 1960.
[9] *Fortnightly Review* (Bank of London & South America Ltd.), 1960, **25**, 1201.



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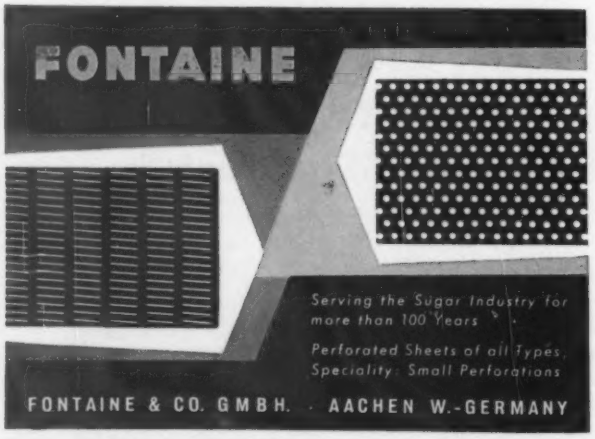
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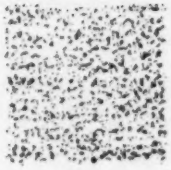

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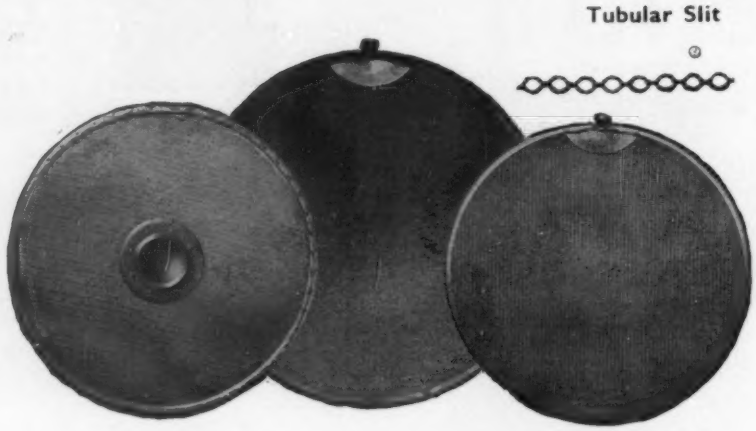


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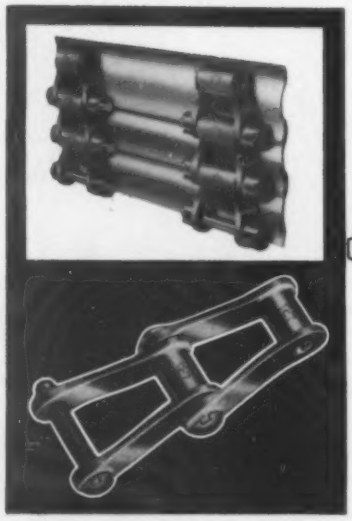

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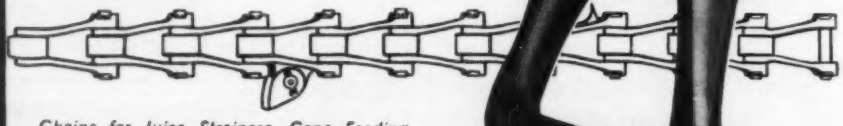

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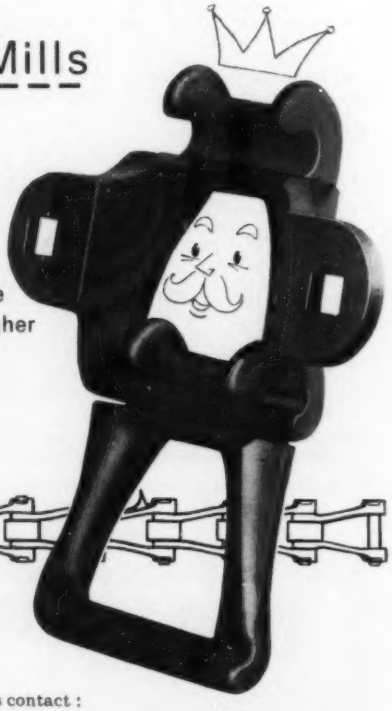

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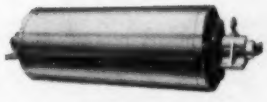

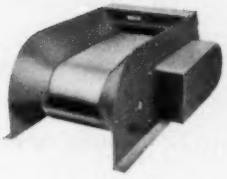

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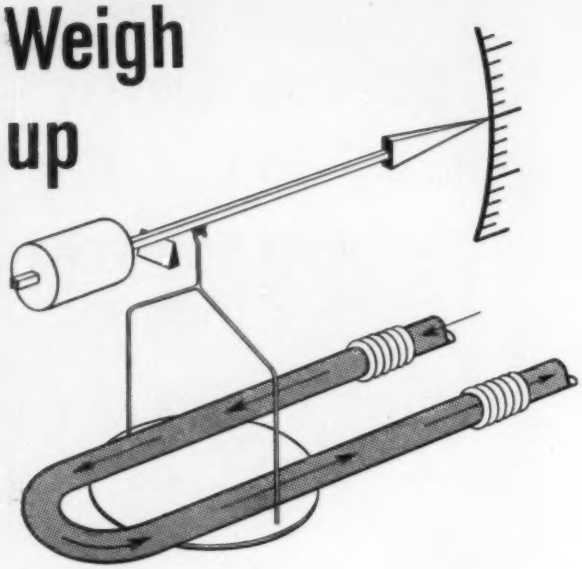

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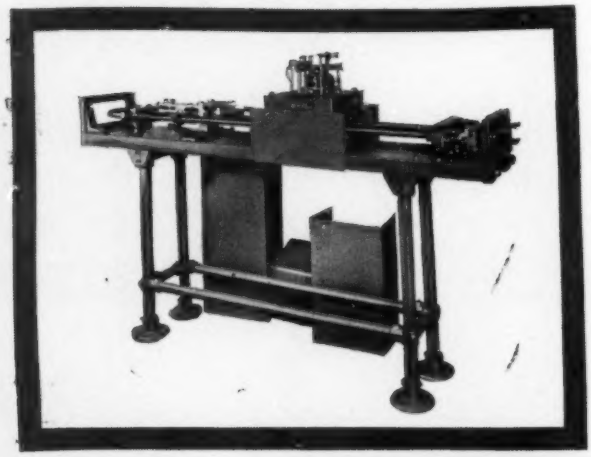

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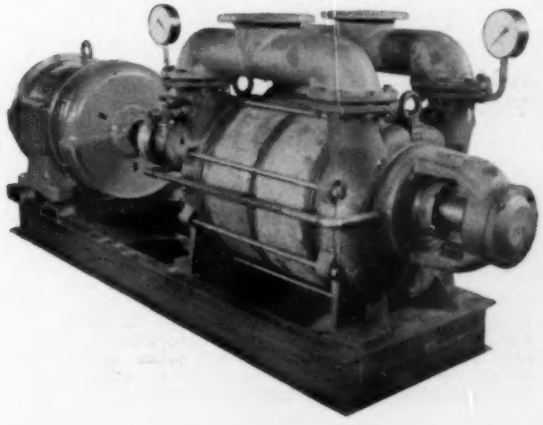

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